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Science aspirations: Investigating the views of 11-14 year old minority ethnic pupils

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Science aspirations: Investigating the views of 11-14 year old minority ethnic pupils

Billy Wong

**Thesis submitted in partial fulfillment of the requirements for the
degree of Doctor of Philosophy**

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Abstract

The importance of science for the economy and the value of scientific literacy in contemporary society are widely acknowledged. However, there are concerns that young people, particularly girls and minority ethnic students, are ‘leaking’ from the science education pipeline (notably the physical sciences). This study draws across sociology of education and science education literature to explore the science and career aspirations of minority ethnic pupils aged 11-14 in London. British pupils from Black Caribbean, Bangladeshi and Pakistani backgrounds were investigated as examples of typically ‘low’ academic achievers and participants in science (e.g. at GCSE and A-level), and British pupils from Indian and Chinese backgrounds were investigated as examples of typically ‘high’ achievers and participants in science education. Forty-six semi-structured interviews, six focus group discussions and 22 hours of classroom observations were conducted with minority ethnic pupils. Five science teachers and one parent were also interviewed. The study aims to explain current uneven patterns of science participation and achievement rates amongst minority ethnic students, focusing on why some students aspire, and others do not, towards science.

The study found that although a diverse range of students aspired to science-related careers, the relationship between students’ achievement, aspirations, interest and capital in science was complex. A typology of ‘student science engagement’ was developed, mapping seven forms of student participation in science. British Black Caribbean students were the least likely, and British Indians were the most likely, to be engaged in science. Many British Bangladeshi students expressed science career aspirations, despite their tendency to have low science achievements, and most British Chinese pupils achieved highly in science, even though few have expressed aspirations towards science. The typology and reasons for these variations were explored using Bourdieu’s notions of habitus and capital, and sociological theorisations of identity (e.g. exploring the purchase of ‘science identity’). The study builds on the small but growing understanding regarding how minority ethnic students experience, aspire and identify with science.

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Preface

I grew up in Aberdeen, Scotland and I was often the only Chinese pupil in my class, if not the year group. A school friend once labelled me a ‘genius’ and in my opinion, it was without merit. I was admittedly doing quite well in some subjects but I was never really the ‘top’ achiever/student in any of my classes. My ethnic background/appearance almost certainly played a role in such perceptions, which, in retrospect, has probably influenced the way I approached education. Unlike popular literature on Chinese families, I never felt or experienced any pressure from my parents to achieve academically. I truly believe I could have left school at 16 without causing much vexation within my family. However, I may have internalised expectations of high academic attainments from what I believed others (such as teachers and fellow students) had expected of me, and as a result, I perhaps felt the ‘need’ to achieve. Although self-analysis does not form part of this thesis, my personal experiences, I believe, have contributed towards my academic interests. I am fascinated by how people like me, or similar to me, have experienced their education when they were in school. I chose to take sociology degrees, at undergraduate and postgraduate level, as I was interested in how people experienced their everyday life differently as a result of their family or cultural backgrounds and social upbringings or environments. In particular, I wanted to know more about people from minority ethnic backgrounds, and how they navigated and negotiated their lives in the UK – which eventually led me to this thesis.

The science focus of my doctoral research derives from my studentship being funded by the ESRC as part of the 5-year ASPIRES project at King’s (part of the ESRC Targeted Initiative on Science and Mathematics Education (TISME) programme) and the Rosalind Driver Research Scholarship Fund. Although I began my doctoral study with limited knowledge about science education, I was already intrigued by national statistics which regularly report a diversity in educational attainment (such as at GCSE and A-level) between students from different ethnic backgrounds. From my initial readings (e.g. Elias *et al.*, 2006), I also found a diversity in participation rates amongst minority ethnic students in science education (*see* Chapter 1). When I was a secondary school pupil I really enjoyed the practical elements of science. Although I found biology, chemistry and physics difficult, I still took Advanced

Higher physics (the equivalent of the English A-level). I even applied to study engineering at university. In hindsight, perhaps I never really considered a career in or from science as something ‘for me’. I wondered the extent to which students from minority ethnic backgrounds aspire towards, and identify with, science.

The importance of science to the economy and for the progression of society is widely acknowledged (Roberts, 2002). In the UK, the ‘leaky science pipeline’ metaphor has been used to describe the relationship between ethnicity and science participation (Elias *et al.*, 2006). Students from specific ethnic groups tend to drop out at various stages of science education, either to pursue alternative career choices or studies, or because they failed to achieve the necessary grades to continue in science. Yet, little is known about the science aspirations of young people from minority ethnic backgrounds. Previous research has found that pupils tend to have a positive interest in science at the end of primary school (aged 10-11), but that enthusiasm appears to decline dramatically by the age of 14 (Osborne, 2008). In response to growing concerns over the early disengagement of minority ethnic students from science education in the UK, this thesis draws across sociology of education theories and science education literature, to explore the science and career aspirations of minority ethnic pupils aged 11-14. This thesis seeks to explain why some minority ethnic students aspire, while others do not, towards science. As subsequent chapters will elaborate, this study investigates three questions:

1. What is the relationship between educational achievement and minority ethnic pupils’ views of and aspirations towards science?
2. To what extent can (i) Bourdieuan theory and (ii) theories of identity provide useful lenses for understanding patterns of science aspirations across different ethnic groups?
3. How do cultural identities and inequalities of ‘race’/ethnicity, social class and gender shape minority ethnic pupils’ views of and aspirations towards science?

The first chapter of the thesis provides the background to the study and examines the concern of a ‘crisis’ in science participation rates. Although more people than ever before are studying science degrees, the number of physics and chemistry graduates remained ‘static’ in the last 25 years (Smith, 2010). Indeed, the science participation ‘crisis’ appears most alarming for the subject physics, where there was a decline in the number of A-level physics students between 1996-2007 (DIUS, 2009). Chapter 1 draws on national and international data on science attainment and participation rates, and sets the scene for an investigation of British students from Black Caribbean, Bangladeshi, Pakistani, Indian and Chinese ethnic backgrounds (aged 11-14, Key Stage 3) – who are typical examples of ‘low’ and ‘high’ achievers (e.g. at GCSE, *see* DCSF, 2002; DfE, 2010a) and participants in science education (Elias *et al.*, 2006).

Chapter 2 explores the complex relationship between students’ attainment, aspirations and engagement in science through the lenses of gender, social class and ethnicity, by drawing on Pierre Bourdieu’s (1977, 1986) notions of habitus and capital, and sociological theorisations of identity. Central to this approach is understanding how individuals (who are socialised and conditioned within particular social identities and inequalities) come to interpret and interact with the social world in specific ways that are considered normal and expected for ‘people like me’.

In Chapter 3, I discuss the methodology and methods of the study, which involved semi-structured interviews, focus group discussions and classroom observations. Details are provided of the participants in the study and how they were recruited. Forty-six students from Black Caribbean, Bangladeshi, Pakistani, Indian and Chinese ethnic backgrounds participated in the study, as well as five science teachers and one parent. The data collected were thematically coded, discursively analysed and theoretically interrogated.

Chapter 4 proposes a typology of ‘student science engagement’, which maps out seven different ways students in the study appear to engage with science. The ‘student science engagement’ typology critically engages with the concepts of ‘science achievement’, ‘science aspirations’, ‘science interest’ and ‘science capital’, and attempts to capture and shed light into the multiple ways in which students can

participate in science. The relationship between students' science achievement and their science aspirations is examined, as well as the influences of gender, class and ethnicity in relation to students' aspirations towards science-related careers. Of particular interest is the finding that some pupils, such as Bangladeshis, tend to express 'high status' and science-related career aspirations despite being low achievers. These students are categorised with *wishful* or *ideological engagements* in science. Other pupils, such as Chinese, tend to excel in science as high achievers despite expressing no interests or aspirations in science. They are considered to have *engagement without interest or aspiration* in science.

In Chapters 5 and 6, I draw on Bourdieu's theory of class reproduction, particularly his notions of capital and habitus as a means for explaining the various ways minority ethnic students aspire to, engage with and achieve in science. In Chapter 5, I explore the economic, social and cultural capital of minority ethnic pupils in relation to their science and career aspirations and find some support towards Bourdieu's social class reproduction theory. However, it is argued that the influence of social class can be complicated by ethnicity, as some British Indian and Chinese students appear to utilise 'middle class' economic capital in relation to education, despite coming from 'working class' backgrounds. The notion of *quality* (i.e. *higher quality* and *lower quality*) is proposed in relation to social capital to distinguish the influences of different types of social networks in shaping students' aspirations towards science-related careers, and a class difference is found in support of the works of Bourdieu. It is also notable that Bangladeshi students in the study tend to lack *higher quality* social capital.

In Chapter 6, I explore the family discourse of 'valuing education', and the educational practices of 'being the best' and 'doing your best' which I have identified from student interview and focus group discussion data. I argued that these educational discourses can inform the habitus to be 'achievement' or 'learning' oriented. Chapter 6 details how pupils sharing an 'achievement oriented' habitus, who tend to be Indian and Chinese students, can strive for high attainment in science without any intrinsic interests or aspirations in the subject, and conversely why pupils sharing a 'learning oriented' habitus, who are predominantly Black Caribbean

and Bangladeshi students, may have ‘high status’ or science-related career aspirations but not necessarily expectations for high academic outcomes.

Chapters 7 and 8 critically engage with the notion of ‘science identity’. In Chapter 7, I investigate students’ views of science and scientists in relation to inequalities and identities of gender, ethnicity and class. Although some students draw on egalitarian discourses of science as a field ‘for anyone’, many students express views of science/scientists as being dominated by ‘white men’. Most students, however, play down class inequality in science. A similar proportion of students across gender, class and ethnic backgrounds expressed views of science as ‘for men’ and as ‘for white people’, with the exceptions of Chinese students who tend to view science as ‘gender equal’ and Pakistani students who tend to view science as ‘racially equal’. More importantly, it is found that students with egalitarian views of science are more likely to express science-related career aspirations than students with stereotypical views of science as dominated by ‘white men’.

Chapter 8 examines the ‘science identity model’ proposed by Carlone and Johnson (2007), who claim that sustainable ‘science identities’ require students to have self-recognition and recognition by others (e.g. such as science teachers) as being competent in science. In Chapter 8, I demonstrate how some students (e.g. such as British Indian girls) can engage with science through the ‘clever identity’ they perceive to be available through the study of, and achievement in, the subject science. However, these students may have little or no interests or aspirations in/towards science, even though they appear to fulfil the criteria for viable ‘science identities’. It is suggested that Carlone and Johnson’s model of ‘science identity’ may need further refining – such as the explicit consideration of students’ science interest and science aspirations – in order to fully elucidate the range of experiences and identifications that minority ethnic students can have in/with science. The dimension of recognition by others as competent in science within the ‘science identity model’ is examined through the views of science teachers toward minority ethnic students. It is found that science teachers tend to (re)produce popular, stereotypical views of minority ethnic groups that are found in mainstream British educational discourses. For example, British Black Caribbean students are typically

seen by science teachers as low achieving and disruptive, while British Chinese pupils are stereotyped as high achieving, diligent students.

Chapter 9 summarises the key findings and implications of the study, and offers six key messages for science educators and policy-makers. This study rejects a ‘one-size-fits-all’ approach and calls for specific initiatives or policies which target particular types of students. For example, some students in the study continue to achieve highly in science despite their apparent lack of interest in, or aspirations towards, science. However, these students are not immune from the science education pipeline, since their career ambitions are not in science-related domains. It is suggested that policy-makers could develop strategies to target this type of students, with the main aim to bolster their personal interests in science, so that these students may approach science with intrinsic as well as extrinsic motivations and develop aspirations towards science-related careers. Chapter 9 also provides a reflection on the thesis and thoughts for future research.

In sum, this study hopes to contribute to the small but growing knowledge base on how minority ethnic students experience, aspire and identify with science as part of their future pathways.

Chapter 1 – The diversity in science participation amongst minority ethnic groups

Introduction

The declining number of students studying post-compulsory science has raised concerns over a potential ‘crisis in science education’ (MacFarlane, 2003). Although the nature of such a ‘crisis’ is debatable (Smith, 2010), there is a striking diversity amongst minority ethnic students in terms of their science participation rates (Elias *et al.*, 2006). Within education, research on minority ethnic groups has tended to focus on issues of racism, achievement and exclusion (Connor *et al.*, 2004; Parsons, 2009; Stevens, 2007; Strand, 2007; Wright, 2010). Few studies – mostly in the US context – have looked into the participations and experiences of minority ethnic students with respect to different subjects in school, such as science (e.g. Brickhouse and Potter, 2001; Brickhouse *et al.*, 2000; Tan and Calabrese Barton, 2007, 2008). Previous research from the US that examined science education and minority ethnic groups has tended to focus on post-compulsory education (e.g. Lewis *et al.*, 2009; Ong, 2005; Russell and Atwater, 2005). Thus, there is a gap in the UK literature concerning minority ethnic groups and their experiences of science, particularly within the school context.

This introductory chapter provides the background and rationale for the current study which explores the views of minority ethnic young people with regards to their participation in, and identifications with, science. The study will shed light on the science experiences and aspirations of British Black Caribbean, British Bangladeshi, British Pakistani, British Indian and British Chinese pupils aged 11-14 in London – the age period in which students’ interest (or lack of) in science appear to consolidate (Osborne, 2008). Although emerging studies in the UK continue to enhance our knowledge of minority ethnic students and their experiences in science education (e.g. Archer *et al.*, 2010b; DeWitt *et al.*, 2011a; Wong, 2011, 2012), the current study will add depth to the growing body of literature, which will be vital for understanding the current attitudes, experiences, aspirations and views of science amongst minority ethnic groups (11 to 14 years old) in an ever-growing,

multicultural Britain. Wohland *et al.* (2010) projected that minority ethnic groups will make up 20% of the UK population by 2051.

This chapter begins by examining the ‘crisis’ in science participation, teasing out the specific sciences and the particular groups of students that are experiencing a decline in science students. Students’ attitudes to and aspirations towards science will then be explored, focusing on minority ethnic students. The influence of parents on minority ethnic students’ science and educational experiences is also discussed. A summary of the chapter highlights some of the key issues to be explored in this study.

‘Crisis’ in science participation

In a speech published on *The Guardian* website, Sir Alistair MacFarlane (2003), the former chair of the Royal Society education committee, called for “urgent action to tackle the crisis in science education and to reverse the decline in the popularity of science, engineering and technology among pupils”. MacFarlane’s comment responds to the falling rate of students studying post-compulsory science since the late-1990s (e.g. DIUS, 2009; Royal Society, 2008). In this section, concerns over the ‘crisis’ in science participation are analysed through the use of national and international statistics, looking at both academic achievement and the number of students studying science at GCSE, A-level and in university. The section begins by providing a background of the importance of science to UK society, such as for economic prosperity and scientific literacy (Osborne, 2007; Roberts, 2002). The scope and scale of the science participation ‘crisis’ is then discussed, focusing on the social axes of gender, class and ethnicity, where differences in achievement and science participations seem most apparent (Banner *et al.*, 2010; DfE, 2011; Elias *et al.*, 2006). In particular, some minority ethnic groups appear to ‘leak’ from the ‘science education pipeline’ earlier than others, creating various forms of underrepresentation (Elias *et al.*, 2006). Ethnic background thus appears to be a central issue in the debate over the ‘crisis’ in science participation.

Why science? The importance of science to UK society

In his foreword to the Department of Trade and Industry (DTI) Innovation Report (2003), the then Prime Minister Tony Blair acknowledges that:

The creativity and inventiveness of our people is our country's greatest asset and has always underpinned the UK's economic success ... We want the UK to be a key knowledge hub in the global economy, with a reputation not only for world-class scientific and technological discovery but also for turning that knowledge into new and profitable products and services (Blair, 2003:3).

The importance of science to UK society is partly proliferated through recognition by the UK government that the economy will increasingly be knowledge driven (Warhurst, 2008). As Powell and Snellman (2004: 201) explain, "the key component of a knowledge economy is a greater reliance on intellectual capabilities than on physical inputs or natural resources". In a review commissioned by the UK government over the future supply of 'high quality' scientists, Roberts (2002) warns that the declining number of UK students with degrees in mathematics, engineering and physical sciences represent a major economic concern for the future health and wealth of the UK economy because science and technology constitute the foundation and progression of contemporary knowledge based societies (Osborne *et al.*, 2009). Thus, economic prosperity seems to be associated, by some commentators, with developments in science and technology (David and Foray, 2002).

In addition to the economic importance of science to UK society, Osborne (2007) and colleagues (Millar and Osborne, 1998; Osborne and Dillon, 2008) argue for the importance of a scientifically informed public in making judgements on moral and political dilemmas generated by developments in science (e.g. cloning, nuclear research). For Osborne (2007), 'knowledgeable' citizens are pivotal for the well-being of science. Unconventional or even unethical scientific initiatives, ideas or research require the support of the general public (the public discourses of 'acceptable' science) (Millar and Osborne, 1998). However, if the general public is poorly informed or misguided, the future of science could be in jeopardy. Hence, the need exists for an informed population who can critically "engage in public debate of the applications and implications of scientific advances" (Osborne, 2007: 177) because, as Osborne continues, "without such critical engagement, public distrust of

scientific expertise is in danger of placing unwarranted restrictions on future research and technological development” (ibid.). Such restrictions could materialise in the form of decreased scientific funding, increased legal restrictions, or even public unrest or protest.

Thus, a case has been made for the importance of the general public to have a ‘reasonable’ understanding of science for the continuing development of science. Although *scientific literacy* (or literacies) is a contested term, with the notion being inconsistently applied in various societies and context (Dillon, 2009), it may be understood as knowledge in science that is generally expected of the wider public, whatever that knowledge may entail. In a similar vein, Millar and Osborne (1998: 9) argued for the need to enhance the scientific literacy of 5- to 16-year-olds, as a basic understanding of science is considered “necessary for all young people growing up in our society, whatever their career aspirations or aptitudes”. Although the aim to educate the wider public may imply the need for changes in the ways scientific knowledge is transmitted (e.g. via schools or the public domain), there remains the concern that the declining number of students studying (particular) post-compulsory sciences may tamper with the future supply of ‘high quality’ UK scientists (Roberts, 2002). The following section explores the extent to which the UK is experiencing a science participation ‘crisis’.

Scope and scale of ‘crisis’: Gender, class and ethnicity

In this section, the scope of the ‘crisis’ in science participation is first discussed to show that such concerns are only relevant amongst particular sciences, such as physics (DIUS, 2009). National and international statistics are then presented on science participation rates and achievements at GSCE, A-level and in university. These data are discussed in relation to gender, class and ethnicity and it is argued that there appears to be a science participation ‘crisis’ amongst some minority ethnic groups (Elias *et al.*, 2006).

The ‘crisis’ in science participation is complicated and problematic because science constitutes a wide range of disciplines and not all sciences experience a decline in participation. According to Smith (2010), there is an increase in the number of

students studying for science degrees in the last two decades, in line with the overall expansion of higher education. However, this growth was driven by the popularity of computer science, sports science and life sciences (e.g. medicine, biology). For example, between 1986 and 2009, the number of students studying computer science (from 3,211 to 11,841), medicine (from 3,841 to 7,063) and biology (from 2,654 to 4,186) have increased substantially in UK universities (Smith, 2010: 289, Table 2). For physics and chemistry, however, student numbers were around 3,000 throughout that period (*ibid.*). Similarly, the DIUS (2009) reports that while the percentage of “first degree qualifiers in medicine and dentistry increased by 34%” between 2002 and 2007, there was a fall of 10% in chemistry graduates. Although Smith (2010) recognises the ‘static’ growth of some sciences such as physics and chemistry, she remains sceptical over the ‘crisis’ in science participation because the sciences, overall, “have retained their share of the undergraduate population” (p. 294). The steady decline (or the lack of growth) in the number of physical sciences students at university is also reflected at A-level.

In a report on the future supply of science, technology, engineering and mathematics (STEM) skilled personnel in Britain, the DIUS (2009) noted that – although an increase in the number of A-level students (18.5%) in England occurred between 1996 and 2007 – the trend for biology and chemistry was almost flat, with a declining number in physics. In 1976, 40,218 individuals took A-level physics; in 1982, it peaked at 53,615 and by 2007, the number had fallen to 23,932 (DIUS, 2009: 44, Table 15). Although the proportion of young people in a cohort who studied A-level physics in 2007 has decreased dramatically since 1976, there was a large increase in the proportion of students who studied A-level biology and a slight increase in students studying A-level chemistry (DIUS, 2009: 46, Figure 14). The Royal Society (2008: 53) reports that while entry to A-level physics fell by 16% between 1996 and 2007, it grew by 1% for chemistry and 8% for biology. Although A-level physics students have risen since 2007 (n=27,786 in 2010, DfE, 2011), the numbers are still 2% lower than in 1996. According to the DIUS (2009), the general decline of A-level science students can reduce the number of potential students eligible to study STEM-related fields in higher education, as students who did not participate in A-level science may already be excluded (or partially barred) from certain disciplines for future study (Elias *et al.*, 2006).

In 2010, girls represented only 21.1% (n=5,852) of A-level physics students, in comparison to 47.7% in chemistry (n=19,255) and 56.2% in biology (n=29,628) (DfE, 2011). The ‘crisis’ in science participation appears most evident in physics (and for girls in particular), with a falling number of students at A-level and in university (DfE, 2011; DIUS, 2009; Smith, 2010). Indeed, in the *She Figures* report funded by the European Union, the proportion of UK female PhD graduates in the physical sciences are 32.6%, but this figure falls to 16.2% in engineering (EU, 2006: 41, Table 2.2). The report found that “women’s participation in the field of science and engineering will decrease in relative terms” (EU, 2006: 17) as the increasing rate of participation for men (2.0%) is still greater than women (0.3%). Similarly, recent figures from the US found that although female maths and science professors to have increased between 1995 and 2003 (from 7.6% to 9.7%), the rate of increase remains ‘very low’ (National Research Council cited in Harmon, 2009).

In England, the study of specific science subjects is usually available at A-level (typically age 16-18). Students doing GCSE (typically age 14-16) generally have the choice to study science at different levels, such as ‘single award’, ‘double award’ and ‘triple award’ science. The majority of GCSE students (*see Banner et al.*, 2010) are likely to encounter school science as a range of science subtopics (i.e. those doing single and double award science), with the exception of triple award science students, where physics, chemistry and biology are taught as separate courses (i.e. the most comprehensive course of science available at GCSE). The teaching of science tends to be undifferentiated at Key Stage 3 (typically age 11-14) and below. Using National Pupil Database (NPD) data, Banner *et al.* (2010) and Homer *et al.* (2011) found the proportion of GCSE students doing single and triple science to have increased between 2005 and 2007, even though over half of all GCSE students study double science, despite the fall from 68.9% in 2005 to 54.7% in 2007. Although Banner *et al.* (2010) found the proportion of girls studying triple science to have increased marginally, from 41.8% in 2005 to 43.0% in 2007, the authors found difference in socioeconomic status, symbolised by recipients and non-recipients of free school meals (FSM), to be most significant in the science participation ‘crisis’. For the purpose of illustration, students from ‘poorer’ financial backgrounds or ‘lower’ social classes are represented by their status as FSM

recipients. In this case, FSM students are ‘heavily underrepresented’ in triple and double award science and ‘heavily overrepresented’ in the ‘lower’ tiers, such as single science (and ‘entry level qualifications’). Only 4.3% of triple science students are FSM recipients (Banner *et al.*, 2010). Such a difference in science participation could pose challenges for FSM students to achieve the necessary grades to participate in science at A-level, because students doing triple science generally achieve higher than students doing double science, who tend to do better than students studying single science (*ibid.*). Science achievement is therefore a relevant issue in the debate about the ‘crisis’ in science participation.

The performance of science students in England has been consistently ‘above average’ in international comparison studies such as PISA 2009 (*see* OECD, 2010) and TIMSS 2007 (*see* Martin *et al.*, 2009; Sturman *et al.*, 2008), which measures the competence of students in science and mathematics in Year 5 (TIMSS, typically age 9-10), Year 9 (TIMSS, typically age 13-14) and at age 15 (PISA, which also includes reading assessments). These age groups correspond to Key Stage 3 (typically age 11-14) and GCSE (typically age 14-16) students in England. Although girls tend to outperform boys in science in ‘high achieving’ countries, such as Finland and Japan, there was no (statistically significant) gender differences for students in England (Martin *et al.*, 2009; OECD, 2010; Sturman *et al.*, 2008), even though boys tend to express higher levels of confidence in learning science than girls (Martin *et al.*, 2009; Sturman *et al.*, 2008). In the international context, the science attainment of English students do not appear as an immediate cause for concern, even though England dropped in the rankings for science achievement from 14th (out of 57 countries) to 16th (out of 65 countries) between 2006 and 2009 (OECD, 2010). Within England, however, students’ achievement in science and education appear to vary considerably by gender, socioeconomic status and ethnic backgrounds, such as at GCSE examinations (DfE, 2010a).

Although no gender differences are found in international comparison studies (e.g. PISA 2009 and TIMSS 2007) in relation to the science achievement of English students, girls in England, on average, are almost eight percentage points more likely to achieve the new benchmark grades at GCSE (i.e. 5 A*-C, including English and mathematics) than boys (58.6% for girls, 51.1% for boys, DfE, 2010a). Indeed,

GCSE gender attainment differences have fuelled public concerns in the last decade over boys' underperformance and girls' overachievement, even though this 'gender gap' is highly contentious (Francis and Skelton, 2005). Nonetheless, national statistics have indicated that girls generally perform better than boys at GCSE (DfE, 2010a). Thus, while girls seem to attain higher than boys at GCSE, this difference in achievement is not reflected in science (Martin *et al.*, 2009; OECD, 2010; Sturman *et al.*, 2008).

As mentioned above, there is a lack of FSM students in the higher tiers of GCSE science (e.g. triple or double award science), which corresponds to their tendency to achieve lower than non-FSM students in national statistics (Banner *et al.*, 2010). Although achievement data on the specific GCSE science (e.g. triple, double and single) are not readily available, only 30.9% of all FSM students in 2010 achieved the new benchmark grades at GCSE compared with 58.5% of non-FSM students (DfE, 2010a). While FSM is used in national statistics as a pragmatic way to classify student achievement by socioeconomic status, it is considered by some as a poor measure of social class because FSM, at best, is only an indicator of family poverty and not all eligible students actually claim FSM (Gillborn and Mirza, 2000; Harwell and LeBeau, 2010). Despite the problems with this measurement, FSM students generally achieve lower than non-FSM students at GCSE examinations (DfE, 2010a), which suggests that students' financial background can influence their science and educational achievements.

In general, minority ethnic groups are underrepresented in the study of post-compulsory science, which is argued to reflect their tendency to 'underachieve' in examinations such as GCSE (Elias *et al.*, 2006). In the UK, a report prepared for the Royal Society of Chemistry and the Institute of Physics stated that "the progress of specific ethnic groups through academic chemistry and physics is modelled using the metaphor of a 'leaky educational pipeline'" (Elias *et al.*, 2006: iii). Along this 'pipeline', individuals of specific ethnic groups drop out at various stages, either to pursue alternative career choices or studies, or because they fail to achieve the necessary qualifications to continue in science. For instance, compared to Chinese (75.1%) and Indian (71.3%) pupils, data from the DfE (2010a) have consistently shown that Black Caribbean (43.5%), Pakistani (49.1%) and Bangladeshi (53.7%)

pupils generally perform below the national average (54.8%) at the new GCSE benchmark grades. Indeed, differences in ethnic groups' achievement were found to exist before GCSE. Data from the DfE (2010b) also shows similar (although less alarming) differences amongst minority ethnic groups in achievements in science at the end of Key Stage 2 (ages 7-11). Thus, Chinese and Indian students, on average, are more likely to achieve the new benchmark grades at GCSE than those of Black Caribbean, Pakistani and Bangladeshi ethnic backgrounds.

According to Elias *et al.* (2006: 8), “many black Caribbean students fall at this first hurdle [i.e. GCSE] and therefore never have the opportunity to make positive choices regarding the study of science”. In other words, the potential number of science students amongst certain ethnic groups can be limited by the early dropouts in school science. Although achievement data in specific GCSE subjects (e.g. triple, double and single science) was not presented in relation to ethnic background, Elias *et al.* (2006: 8) were content that the “lack of attainment at GCSE level alone potentially goes a long way to explaining the lack of black Caribbean scientists at university”. For instance, in relation to the white (and predominately British) population, Chinese (+220%) and Indian (+54%) students were proportionally overrepresented in the number of ‘potential physics undergraduates’ (i.e. eligible pupils with UCAS 18 or above, including A-level physics), whereas students of Black Caribbean (-82%), Pakistani (-79%) and Bangladeshi (-26%) ethnic origins were proportionally underrepresented (Elias *et al.*, 2006: 10). For those actually studying physics at the undergraduate level, for instance, only Chinese students (+31%) were proportionally overrepresented, with Indian (-61%), Black Caribbean (-80%), Pakistani (-92%) and Bangladeshi (-18%) students all being proportionally underrepresented (Elias *et al.*, 2006). These findings were similar to an earlier study by Jones and Elias (2005), who also found that Chinese and Indian students were proportionally overrepresented (‘double’, 100%) in science, engineering and technology (SET) degrees. Using data from HESA (2001-2), UK-domicile Chinese and Indian students constituted approximately 0.73% and 2.46% of the British higher education student population (in 2001-2), but approximately 1.50% and 5.48% of students studying SET degrees (Jones and Elias, 2005). From these data, Chinese and Indian students appear most likely to achieve the new benchmark grades at GCSE, to be ‘potential physics undergraduates’ (i.e. to have obtained A-

level physics), and to participate in science in higher education than Black Caribbean, Pakistani and Bangladeshi students, who tend to ‘leak’ from the ‘science education pipeline’ during earlier stages (e.g. GCSE, A-level).

As previously mentioned, although FSM students tend to achieve lower than their non-FSM counterparts at GCSE, such differences vary within and across ethnic groups (DfE, 2010a). Statistics from the DfE (2010a) showed that 68.4% of Chinese pupils on FSM attained 5 A*-C GCSE (including English and mathematics) in comparison to 75.8% of non-FSM Chinese students (difference of 7.4 percentage points). Amongst Black Caribbeans, the figure for FSM students is 33.1%, rising to 46.5% for non-FSM (difference of 13.4 percentage points). Similar differences are noted amongst Pakistani and Bangladeshi pupils, with a greater difference amongst Indian pupils (difference of 18.2 percentage points). Perhaps surprisingly, the largest increase between students of non-FSM and FSM are white British, from 25.3% to 58.6% (difference of 33.3 percentage points). Thus, the influence of socioeconomic status in relation to GCSE attainment appears more relevant for white British than for minority ethnic students (DfE, 2010a; Gillborn and Mirza, 2000). Based on the above figures, although non-FSM students clearly outperform FSM pupils, the difference in attainment is only significant within each ethnic group (*see also* Rethon, 2007). For example, *only* 68.4% of Chinese students on FSM attained the new benchmark grades at GCSE, relative to 75.8% for non-FSM Chinese students (hence socioeconomic status may account for the 7.4 percentage point difference in achievements for Chinese pupils). However, in relation to the national average or to other ethnic groups, an achievement rate of 68.4% at GCSE is still higher than most ethnic groups, with or without FSM (e.g. national average is 58.5% for all non-FSM and 30.9% for all FSM students, DfE, 2010a). Thus, the significance of social class on GCSE achievement seems more relevant *within* rather than *across* ethnic groups, since the attainment differences between FSM and non-FSM students are dependent upon their ethnic backgrounds (Gillborn and Mirza, 2000).

Indeed, previous studies have tended to examine the influence of gender, class and ethnicity separately, which neglects the interaction of these inequalities, or what Hill Collins (2000) refers to as the ‘matrix of domination’, which recognises the multiple nature and interrelatedness of social inequalities. For example, a black woman may,

like all women, experience some form of gender inequalities. However, she may also experience racial inequality due to her black racial background. Thus, the experiences of black women are likely to be different from the experiences of other women (e.g. such as white), because they share different racial/ethnic backgrounds (Hill Collins, 2000). Similarly, popular models or theories of social class (e.g. Bourdieu, 1977, 1986) appear to have been developed in relation to (predominately or assumed) white populations, which do not necessary extend to minority ethnic groups (Archer and Francis, 2007). It is necessary, therefore, to recognise the interactions and multiple natures of social inequalities and identities (*see* Chapter 2).

The debate over the science participation ‘crisis’ is multidimensional because only some sciences, such as physics, are experiencing a decline in A-level students and degree graduates (Smith, 2010). In this section, the scope of the ‘crisis’ in science participation was analysed through the social axes of gender, class and ethnicity. Although girls account for over 40% of those studying triple science, boys continue to dominate A-level physics (Banner *et al.*, 2010; DfE, 2011). However, differences in socioeconomic status, indicated by free school meal (FSM) status, found FSM students generally achieve lower than their non-FSM counterparts at GCSE examinations (DfE, 2010a) and ‘heavily underrepresented’ in the study of GCSE science at the highest tiers (e.g. triple and double award science, *see* Banner *et al.*, 2010). However, such differences are only significant *within* but not necessary *across* ethnic groups. The influence of social class on science participation and GCSE attainment in general seems to vary amongst students from different ethnic backgrounds. Indeed, there seems to be a ‘crisis’ in science participation amongst students from particular minority ethnic backgrounds, such as Black Caribbean, Pakistani and Bangladeshi, who tend to achieve below the national average at GCSE examinations (DfE, 2010a) and are ‘proportionally underrepresented’ in the study of science at A-level and in university (Elias *et al.*, 2006). Chinese and Indian students, on the other hand, are ‘proportionally overrepresented’ in the study of and achievements in post-compulsory science (*ibid.*). As little is currently known about the experiences of minority ethnic students in school science, there is merit in this thesis to investigate and explore the possible reasons for the differences which exist amongst these minority ethnic groups, their educational achievements and their participations in science.

Understanding attitudes and aspirations: Science and education

In this section, concerns over the ‘crisis’ in science participation are explored in relation to students’ attitudes to and aspirations towards science and education. As previous studies have found a small correlation between positive science attitudes and higher science achievement (Papanastasiou and Zembylas, 2002; Köller *et al.*, 2001), knowledge of students’ attitudes towards science can help researchers to understand the ways in which students engage, achieve and participate in science. Indeed, the declining number of A-level science students seems to correspond with the general fall in positive attitudes expressed by students towards school science (Jenkins and Nelson, 2005). The age period 11-14 in which students seem to consolidate their views of science is also discussed in this section (Osborne, 2008). The notion of aspiration is then argued to be a useful focus for understanding students’ views towards science (Tai *et al.*, 2006). Enquiries into students’ aspirations can offer insightful perspectives into the educational and occupational routes students intend to pursue. Since there is diversity in science participation amongst minority ethnic students (*see* earlier section), the aspirations of students from Black Caribbean, Bangladesh, Pakistani, Indian and Chinese backgrounds are explored. This section argues that the notion of aspiration can be a useful lens for understanding the ways in which students participate in science.

Student attitudes towards science: ‘Not for me’

Attitude is defined as ‘a settled way of thinking or feeling about something’ (Oxford Dictionaries, 2010) and it can be one’s opinion or view towards someone or something and it can be positive, negative or neutral. In England, there remains a growing concern over the lack of student interest in science and STEM-related careers (Jenkins and Nelson, 2005), which corresponds to the ‘static’ growth in the number of A-level science students in the last decade (DIUS, 2009). The TIMSS 2007 survey reports that the percentage of year 9 (typically age 13-14) English students with ‘highly positive’ attitudes towards science has fallen by 21 percentage points since 1999 (Sturman *et al.*, 2008).

In a survey of 1,277 14- and 15-year-old English students on their attitudes towards science, Jenkins and Nelson (2005) found that students generally perceived science as important and interesting, but few aspired to become scientists or said that they preferred school science to other subjects. In other words, although students generally viewed science in the positive light, such that it was ‘interesting’, many also considered science as ‘not for me’ (Jenkins and Nelson, 2005). Indeed, only 8% of students answered ‘agree’ to the question ‘I would like to become a scientist’, compared to 79% who responded ‘disagree’ or ‘low disagree’ (Jenkins and Nelson, 2005: 45, Table 1). Osborne (2008: 71) noted that, “Whilst science might be perceived as quite interesting, it is seen as ‘not for me’ by many young people because it is too strongly identified with becoming a scientist or engineer”. As such, the idea of becoming a scientist or working in a scientific field appears unattractive to many youths. Furthermore, Sjøberg and Schreiner (2006) cautioned that interest in science (in general) does not necessarily correspond with positive attitudes towards school science, as science taught in school tends to be very different from science in general. Millar and Osborne (1998: 5) noted the increasing discrepancy between science as portrayed in contemporary media and science taught in the school curriculum, which “fails to sustain and develop the sense of wonder and curiosity of many young people about the natural world”. Indeed, the authors found several areas of concern with the school science curriculum, including teaching content that was outdated, repetitive, uninspiring, too focused on fact-learning and lacking relevance to everyday life (*see also* Barmby *et al.*, 2008).

Such views were elaborated upon by Osborne and Collins (2001), who conducted 20 focus groups with 144 16-year-old pupils in England and found a general consensus amongst the pupils that school science was generally more difficult than other subjects, as well as boring, compacted, segmented and irrelevant to real-life situations. The perceived difficulty of school science may be attributed to the (apparent) analytical and complex nature of the subject as well as the ways in which school science was taught and experienced by pupils. For example, as school science tends to rely heavily on facts (text) transmission, memorisation constitutes the central learning mechanism. In other words, school science is dominated by “facts to be learned” (Osborne and Collins, 2001: 452). The authors also reported annoyance amongst some pupils towards the lack of scope for negotiation or discussion within

the science classroom, with scientific knowledge taught to be accepted, which limited creative thinking or imagination. Furthermore, to pupils' dismay, school science was fragmented in an attempt to cover a wide range of different sciences, ultimately creating an inconsistent, incoherent and 'rushed' learning process for pupils. Although encounters with school science were not all negative, Osborne and Collins (2001) highlighted some of the issues that pupils themselves identified as contributing to their (negative) attitudes and experiences of school science. On a positive note, Jenkins (2006) cited findings from the OCR (2005), which surveyed 950 14- to 16-year-old pupils in England and found that 66% of students 'had something positive to say' about school science, with 54% opting for 'interesting', 14% for 'fun' and 12% for 'exciting'. Indeed, as discussed in the next section, attitudes and interests towards science are mainly positive amongst primary schoolchildren (typically age 7-10, *see* Archer *et al.*, 2010b; Jarvis and Pell, 2002), which suggests that the lack of science interest amongst older students (e.g. ages 14-15, *see* Jenkins and Nelson, 2005) may have developed as they experienced secondary school science.

The 'critical' period in science interest: Age 11-14

According to Osborne (2008), a growing number of studies have indicated that, by age 15, students tend to lose interest in school science relative to other school subjects (Jenkins and Nelson, 2005; Osborne and Collins, 2001). Support for this view comes from Tai *et al.* (2006), Bennett and Hogarth (2009) and Lindahl (2007), who found that students' career aspirations and science interest were largely formed by age 14 (in the US and England) and 13 (in Sweden). Furthermore, Cheng *et al.* (1995) pointed out that science and mathematics achievement at GCSE is the most important factor in the potential take-up of physical sciences at a later stage (e.g. A-level). As emphasised in a report by the DIUS (2009: 5), "the greatest loss ... is the proportion of young people that do not go on to attain any A-level qualifications [in STEM-related fields]". The current 'crisis' in science participation may stem from the different levels of science students take at GCSE (e.g. single, double and triple science), which can ultimately limit the number of potential science students further down the science education pipeline (Elias *et al.*, 2006).

This leads to the following question: At what stage (or age) do students generally begin to lose interest in school science? In general, positive attitudes to science are found to decline with age. Jarvis and Pell (2002) found that, as primary pupils (typically age 7-10) get older, interest in science declines as children find it easier and less challenging. In a report prepared for the Wellcome Trust, Murphy and Beggs (2005) concluded that many students began to lose interest in school science from the age of 10. Older children (ages 10-11) are less positive towards science than younger pupils (ages 8-9), despite more confidence in ability. Indeed, the authors found age to be more significant than gender in relation to attitudes towards school science. According to Silver and Rushton (2008), whereas attitudes to science amongst year 5 (ages 8-9) primary school children were very positive in general, such that it was seen as beneficial for society, very few envisioned becoming a scientist or engineer. The study found that year 5 boys and girls were equally negative about the prospects of becoming an engineer or scientist themselves (*see also* Archer *et al.*, 2010b). Thus, existing studies seem to suggest that the critical period during which students begin to lose (or form) interest in science occurs between ages 11 and 14 (e.g. Key Stage 3).

In the following section, the lack of student interest in secondary school science is explored through the notion of aspiration, which is argued to be a useful way in understanding students' attitudes to and achievements in science.

Aspiration as a useful focus

The *Oxford Dictionary of English* (Oxford Dictionaries, 2010) defines an aspiration as 'a hope or ambition of achieving something'. For individuals, an aspiration can constitute their desires, intentions and expectations for the present and future. Educational aspirations refer to individuals' ambitions in the educational setting (Strand and Winston, 2008). For example, for students in compulsory schooling, educational aspirations may refer to the intentions to pursue further or higher education. At different stages along the education ladder, student aspirations vary. At each stage of a student's life (e.g. in England), particular sets of occurrences are socially structured, such as the transition from primary to secondary school (typically ages 10-11), the selection of GCSE (or '14-19 Diplomas', typically ages

14-15) and post-compulsory schooling plans (currently age 16, will be 17 from 2013 and 18 from 2015, *see* Education and Skills Act 2008).

The relationship between achievement and aspirations is complex, with some studies implying that *only* students with high attainment command high aspirations (Schoon and Parsons, 2002; Shrigley, 1990). For example, a student excelling in a certain subject, demonstrated by competence in assessments or exams, might be achieving a high standard because the student is interested in the subject and therefore wants to do well in it. Similarly, it could also be this high achievement in the subject that encouraged the student to continue achieving and even develop an interest in the subject (Epstein *et al.*, 1998). In other words, students may aspire to a certain field because they are, for whatever reason, good at it (as confirmed by exams). In educational policy and research, ‘low’ (or lack of educational) aspirations are sometimes blamed for the lower rates of ‘working class’ and (particular) minority ethnic students in achieving the new benchmark grades at GCSE (Duckworth *et al.*, 2009) and in participating post-16 schooling (DCSF, 2007, 2009; DfES, 2005). There have been initiatives which set out to ‘raise’ the aspirations of young people (e.g. *Aimhigher*, *Aiming High*, *REACH*) by providing students with educational and career roadmaps and information, with the goal in promoting higher achievement and participations in post-compulsory education (DfES, 2003). For researchers, knowledge about young people’s educational aspirations is important because decisions made in compulsory schooling (such as GCSE subject choice) can direct, restrict and limit certain career paths. However, occupational (i.e. career) aspirations do not necessarily correspond with educational aspirations, since a desired career can operate at an ideological level (e.g. a ‘dream job’, *see* Mickelson, 1990).

The use of aspiration as a lens to understand students’ science achievement has previously been conducted in a longitudinal study of American students by Tai *et al.* (2006: 1144), which found that “students with expectations for a science-related career were 3.4 times more likely to earn physical science and engineering degrees than students without similar expectations”. The authors also found that “an average mathematics achiever with a science-related career expectation has a higher probability [34%] of earning a baccalaureate degree in the physical sciences or engineering than a high mathematics achiever with a nonscience career expectation

[19%]” (ibid.). Thus, aspirations (towards science) appeared positively linked with achievements (in science). Aspirations toward science can constitute one’s ambition to flourish within the scientific field, whether in education or occupation. As the number of students studying science at A-level and in university is declining (DIUS, 2009), particularly amongst certain minority ethnic groups (Elias *et al.*, 2006), the current study – which looks into minority ethnic students and their science aspirations – could offer valuable insights into their tendency to be ‘proportionally underrepresented’ (e.g. Black Caribbean, Pakistani and Bangladeshi students) and ‘proportionally overrepresented’ (e.g. Chinese and Indian students) in the study of post-compulsory science (Elias *et al.*, 2006).

Aspirations can be shaped and reshaped by a number of interweaving factors. Some influences may be unique (e.g. personal experiences or encounters) while others can be termed as a *social process* where people of certain characteristics or backgrounds, at a particular time (and location), are likely to experience or encounter. These social structures can include age, gender, socioeconomic status and ‘race’/ethnicity (Archer *et al.*, 2010a). For example, older children tend to hold aspirations that are more ‘realistic’ than their ‘idealistic’ younger counterparts due to their longer engagement with the ‘real’ world and deeper understandings of achievable aims (Kao and Tienda, 1998). Girls and boys tend to have different career (and educational) aspirations, reflecting societal expectations and/or perceived gender roles (Gutman and Akerman, 2008). Although these social processes are by no means homogeneously experienced, differences in aspirations amongst certain groups can be viewed as the consequence of particular social processes, such as gender, class and ethnicity, which is discussed next.

Understanding aspirations: Gender, class and ethnicity

As discussed earlier, there is diversity amongst minority ethnic groups and their participations in post-compulsory science education. This section examines how aspirations could be shaped by gender, class and ethnic background, focusing on Black Caribbean, Bangladeshi, Pakistani, Indian and Chinese students.

Gender differences in aspirations are often associated with the perceived and prescribed roles of gender within certain cultures or societies (*see* Blickenstaff, 2005 for review; Archer *et al.*, 2007a; Mendick, 2006). For instance, popular perceptions of science as a male domain may be crucial in understanding the general lack of interest expressed by girls in relation to science-related careers (Frome *et al.*, 2006). Girls may be reluctant to participate in particular sciences because they perceive the identities of scientists and engineers (e.g. being ‘for men’) as inconsistent with their own (e.g. female) identities (*see* Ceci and Williams, 2007 for review; Osborne *et al.*, 2003; Schreiner and Sjøberg, 2007). This view is supported by earlier studies that indicated that STEM subjects (especially physical sciences) are typically seen as masculine subjects (Whitehead, 1996). Girls seem to choose and prefer subjects and careers that reflect their feminine identity (Francis, 2000b). Furthermore, Correll (2001) notes the significance of ‘gender beliefs’ in forming gender stereotypes, which can consciously or subconsciously influence one’s aspiration to reflect (or conform to) society’s norms and expectations of particular genders or groups. Knowledge or information that confirms gender stereotypes is more likely to be maintained than that which challenges gender expectations (Skelton *et al.*, 2006). As science is generally viewed as masculine and being in the male domain, there remains the popular belief that science is for boys (Harding, 2006). Involvement with science may appear or be interpreted to be inconsistent with the self-identity or position of girls, even though girls tend to achieve slightly higher grades than boys in science (e.g. such as A-level physics, where 38% of girls achieved A* or A in comparison to 32% of boys, DfE, 2011), despite the declining number of female participants at A-level physics (DfE, 2011; DIUS, 2009; Smith 2010).

According to Haste (2004), it is not that girls are not (or less) interested in science, but rather that they have different interests and aspirations in/towards science that are not equally acknowledged. For instance, Jenkins and Nelson (2005) listed 108 topics that students (ages 14-15) would like to learn in science and found that the top five items drastically differ between boys and girls. Whereas boys listed items such as explosions, weapons and outer space as topics they would most like to study, girls were generally more interested in topics such as cancer, first aid and health maintenance. According to Miller *et al.* (2006), girls tend to be more ‘people-centred’ and their interests and aspirations in/towards science may reflect people-

oriented values, such as sciences that are perceived to help people and that require working with people. In relation to school sciences, this may partially explain the overrepresentation of girls in biology (e.g. A-level, DfE, 2011), which was found to be the exception in girls' generally lower interest in school sciences (Miller *et al.*, 2006; Murphy and Whitelegg, 2006). For instance, human biology makes references to life, such as the human body, and it may appear more relevant or consistent with people-centred values. For girls, biology may encompass more obvious values of helping others or working with people than physical sciences. Similarly, Miller *et al.* (2006) examined science attitudes amongst 79 high school students (in the US) and found that girls intending to major in biology (or science) sought to pursue a medical or health profession (which seems to correspond to people-orientated values). Girls appear to articulate people-centred values in their science-related aspirations. Such a preference may reflect societal expectations (or constructions) of gender roles, with females typically associated with the role of nurturing and motherhood (Paechter, 2007).

Previous studies on social class and aspirations tend to follow the doctrines of a social class reproduction system (albeit with some modifications), where those of privileged backgrounds (within a society) tend to aspire and successfully maintain privileged positions across generations (Ball *et al.*, 2002b; Reay, 1998). In relation to science, Adamuti-Trache and Andres (2008) used 10 years of longitudinal data tracking 1,055 young Canadian men and women and found that students with university-educated parents are more likely to plan their career and choose to study science than students with non-university educated parents. For the purpose of illustration, the former (i.e. students with university-educated parents) are considered to be from 'middle class' families while the latter (i.e. students with non-university-educated parents) represent 'working class' backgrounds. As such, this study – as with many others (e.g. Gorard and See, 2009) – has implied a relationship between social class and aspiration (or decision) to study science, with the 'middle class' being more likely to aspire to a degree in science. This pattern may reflect the social status of scientific degrees, which – in many Western societies – may be considered (or perceived) to be of more 'value' (or prestige) than other degree types, such as arts or social sciences (which are deemed to be 'easier' to acquire) (Osborne *et al.*, 2003).

Similarly, ‘middle class’ students tend to aspire to ‘traditional’ universities more than ‘new’ universities, while the opposite appears true for the ‘working class’, who are overrepresented in ‘new’ universities and tend to view ‘traditional’ universities as ‘not for them’ (Archer *et al.*, 2007b; Archer and Yamashita, 2003; Ball *et al.*, 2002b; Reay *et al.*, 2001; Smith, 2007). Such views were also found amongst minority ethnic groups (Shiner and Modood, 2002), although Ball *et al.* (2002a) claimed that social class is more significant than ethnicity in relation to university choice. Thus, social class differences in aspirations, either in degree choice or choice of university, appear to suggest that the ‘middle class’ aspire to more prestigious, more valuable, and more respected degree and university types. In this case, science is considered (or perceived) to be a degree of more (or even ‘most’) prestige and thus, social class can be a key determinant of aspirations in science. Chapter 2 will further examine the significance of social class in relation to science aspirations.

In relation to ethnic background, the association between students’ aspirations and their achievements appear dubious. In studying the educational aspirations of 849 inner-city school pupils in England, Strand and Winston (2008) commented that minority ethnic pupils tend to command higher aspirations towards education than those from ‘white working class’ backgrounds. The authors found no significant differences in aspirations by gender or age group, but noted important differences between ethnic groups. For example, amongst those aged 12-14, white British ‘working class’ pupils had the lowest aspirations towards education, with 80% of pupils intending to continue full-time education beyond compulsory schooling (currently age 16). This percentage rises to 87% for Black Caribbean, 97% for Asian Other (classified as ‘Indian, Chinese, Other’), 90% for Pakistani and 86% for Bangladeshi pupils. Similar findings were also noted in reports by the Cabinet Office (2008), Connor *et al.* (2004) and Strand (2007). Strand and Winston (2008) concluded that the higher aspirations of minority ethnic groups (relative to ‘white working class’) may be attributed to the desire for upward social mobility.

The comparatively higher aspirations of minority ethnic groups pose an interesting contrast to the reality of educational achievements. For instance, using the previously cited figures (Strand and Winston, 2008), 90% of Pakistani pupils aspired to post-compulsory education yet only 49% achieved the new benchmark grades at GCSE

(DfE, 2010a). It is important not to assume that pupils who did 'less well' cannot, or do not, aspire to further/higher education, yet the discrepancy between high aspirations and low achievement should not be overlooked. According to Mickelson (1990), the disparity between high/positive attitudes and low achievement can be understood in terms of the 'attitude-achievement paradox', which distinguishes 'abstract' and 'concrete' attitudes. In relation to education, the former entails the uptake of the meritocratic ideology as publicised by dominant education discourses, whereas the latter reflects the actual experiences of students, which can often include various forms of inequality, racism or discrimination (*see* Wright, 2010). Thus, aspirations and achievement can operate on parallel tracks, meaning one does not necessarily depend on or correspond to the other (Mickelson, 1990). For some minority ethnic groups, high aspirations can often be thwarted by various constraints (or experiences) in reality.

In this case, the relationship between aspirations and attainment entails a varying, if not depressing, association amongst minority ethnic groups. Chinese and Indian students appear to command both high aspirations and attainment in education, while Black Caribbean, Bangladeshi and Pakistani pupils, as a group, tend to have high educational aspirations but below average scores at GCSE (DfE, 2010a; Strand and Winston, 2008). The complexity of this relationship calls for an inquiry concerning the formation of aspirations in relation to the attainments of minority ethnic students. For instance, why do some minority ethnic students, but not others, successfully translate high aspirations into high educational achievement? Can the discrepancy between aspirations and achievement be explained by ethnic and cultural differences? To address these questions, it would be helpful to gain an understanding of the aspirations expressed by students from minority ethnic backgrounds, which also tend to vary by gender.

Although Black Caribbean students generally express aspirations for post-compulsory education (Strand and Winston, 2008), existing studies have reported notable differences between the ambitions of girls and boys. Kerpleman *et al.* (2008) studied 374 African American students in grades 7-12 (ages 12-18) and found that boys, irrespective of academic ability (as indicated by exam results), have on average lower 'future education orientations' than their female counterparts. Likewise, in the

UK, Mirza (1992) noted that black girls (mainly of West Indian origin) generally aspired to non-manual 'middle class' professions, such as in health and childcare, while young black boys were less optimistic about their career options. For Mirza (1992), young black girls were aspiring to 'known routes' in the fields of caring and nursing that were proven to be accessible (by black women). They were seen to have realistic ambitions, expressing desires for upward social mobility while recognising the constraints of accessibility (e.g. racism).

Studies from the US (e.g. Ferber, 2007) also noted that young African American boys do not generally aspire towards education because their ambitions were more focused in the fields of sports and athletics. This may be because, within American (and British, *see* REACH, 2007) public discourses, the 'success' of African American and Black British sports figures is more 'visible' (and hence may be seen as more achievable). Indeed, with televised sports still being largely male dominated, the apparent 'success' of African American and Black British males may serve as role models for black youths in that sports are projected as possible and achievable career paths (Csikszentmihalyi and Schnieder 2000; Ferber, 2007; REACH, 2007).

As can be seen, previous studies appear to indicate a gender difference in terms of future ambitions, with black girls aspiring to 'middle class' professions and black boys to sports. Although Mirza's study was conducted in the late 1980s, more recent studies from the US suggest that girls of Caribbean (and African) origin tend to exert comparatively higher educational aspirations than their male counterparts (Kerpleman *et al.*, 2008). However, such findings should be read with caution as aspirations (either educational or occupational) are also influenced by other social and societal factors and do not necessarily translate into high educational or occupational outcomes (Mickelson, 1990).

Although previous literature does not draw a homogeneous picture with regards to the aspirations of Muslim students, girls of Bangladeshi and Pakistani ethnic origin seem to have high aspirations in both education and occupation, with university degrees and careers in medicine, accountancy or finance being considered (Dale *et al.*, 2002). Aspirations in the physical sciences, however, appeared unattractive (or even unknown) amongst Bangladeshi girls (Smart and Rahman, 2009). For

Bangladeshi and Pakistani boys, aspirations in education appear high, similar to the girls, but in relation to careers and occupations, there seems to be a mixed response (Archer, 2003; Salway, 2008).

Against popular discourses of Muslim girls as being oppressed and restricted to the domestic domain, Archer (2002a) and Ahmad (2007) found that Muslim girls (of predominantly Bangladeshi and Pakistani ethnic origin) generally commanded high educational aspirations (e.g. such as university education). Dale *et al.* (2002) reasoned that some Muslim girls aspired to pursue education as an ‘escape route’ for independence, especially for married women, because a university degree (or professional job) could enable more currency to bargain for more freedom within the household (or better marriage prospects). In a report on British Bangladeshi girls and STEM participations, Smart and Rahman (2009) found that Bangladeshi girls likened the study of science and mathematics to medicine, accountancy and finance – careers that many Bangladeshi girls were found to aspire to. Biology and chemistry were considered ‘good subjects’ by Bangladeshi girls and parents because of their association with medical careers, and mathematics is related to accountancy and finance professions. Thus, Bangladeshi and Pakistani girls appear to command high educational and career aspirations, but consistent with broader gender discourses, they expressed little enthusiasm towards the physical sciences (Miller *et al.*, 2006).

In a study of Muslim boys (of predominantly Bangladeshi and Pakistani ethnic origin) in English schools, Archer (2003) found that the majority maintained positive attitudes towards education, viewing it as important for social mobility and a prosperous career. This view is consistent with the traditional male breadwinner model commonly found in Bangladeshi and Pakistani family discourses (Dale *et al.*, 2002). However, with regards to career aspirations, which can influence aspirations in education, some boys also viewed the family business (e.g. restaurants and local shops) as a ‘safety net’ should other options fail (Archer, 2003; Shah *et al.*, 2010). Similarly, Salway (2008) found young Bangladeshi men (ages 18-35) in the UK generally had low career aspirations and were heavily dependent upon intra-ethnic networks for local employment, which can potentially limit their encounters with racism (Cabinet Office, 2008; Salway, 2008). From the above studies, Bangladeshi

and Pakistani boys appear to value education highly but hold inconsistent views on potential careers and future occupations.

As examples of high achievers, Chinese and Indian pupils are more likely to attain the new benchmark grades at GCSE than any other ethnic groups in England. According to statistics from the DfE (2010a), Chinese girls are the top achieving group, with 80.5% earning 5 A*-C including English and mathematics, followed by Indian girls (75.2%), Chinese boys (69.6%) and Indian boys (67.7%). Thus, even amongst the highest-achieving minority ethnic groups, girls' achievement is approximately 10 percentage points higher than their male counterparts. However, in relation to aspirations, the *insignificance* of gender and social class can be illustrated in the example of Chinese students, who appeared to be *unaffected*. In their study of the educational experience of British Chinese pupils, Archer and Francis (2007) found that the 80 pupils (aged 11-18) in their study were all in agreement, regardless of their gender and social class background, that education is important and success is achievable through hard work. All of the 80 Chinese pupils aspired to university education, with a number of them already indicating their intent to pursue postgraduate studies. Mathematics was by far the most popular subject amongst British Chinese boys and girls, with science ranked second for boys and third for girls. According to the authors, there appears to be a "general liking for traditionally masculine subjects" amongst British Chinese pupils (Archer and Francis 2007: 93), irrespective of gender, illustrating the interaction effects of ethnicity (or ethnic culture) with gender, as Chinese girls seem to prefer 'masculine' mathematics and science subjects to 'feminine' subjects in the arts and humanities. As argued by Archer and Francis (2007: 94), the preferences (and aspirations) of British Chinese pupils "may reflect discourses produced by their 'cultural' perspective and the interaction with/positioning of these by the dominant Western discourses sustaining the British educational system". British Chinese pupils may not view subjects such as mathematics and science in terms of 'masculinity', but rather, as highly desirable subjects within Chinese family discourses.

According to Sham and Woodrow (1998), British Chinese pupils chose to study subjects related to future jobs, perceiving education as the necessary means to pass examinations. In this case, aspirations in education are strongly associated with

career aspirations. The strong subject preference of science and mathematics amongst British Chinese pupils (Archer and Francis, 2007) may reflect on the perception or belief that mathematics and science offer the best potential in terms of future educational or occupational prospects (DIUS, 2009). Such a perspective could be identified as a ‘middle class’ discourse, which tends to value science (and mathematics) as the superior and more challenging subject (Adamuti-Trache and Andres, 2008). However, for Chinese pupils, acknowledging the importance of science and mathematics may reflect cultural (or ethnic) rather than social class values. Archer and Francis (2007: 94) noted that a preference for mathematics or science may be “an example of the cultural impact on discursive and social resources”. Thus, amongst Chinese pupils, the influence of gender and social class appears limited with regards to (educational) aspirations, as Chinese boys or girls from various social class backgrounds seem to hold high (or ‘middle class’) aspirations.

Although limited literature exists on Indian pupils’ educational aspirations, available statistics suggest a similar pattern to Chinese pupils, as Indian pupils also achieve highly at GCSE examinations (DfE, 2010a). For career aspirations, Springate *et al.* (2008) noted a high preference amongst Indian students to work in the fields of medicine and dentistry. Such aspirations appear to originate from family ambitions, which are discussed later in the chapter. Elias *et al.* (2006: 26) found that in 2002-3, Indian students made up “27% of all dentistry [undergraduate] students, 19% of all pharmacology students and 32% of all ophthalmic students” in England and Wales. Indian students, overall, accounted for just 5% of all undergraduate students (in 2002-3), yet they have a significant representation in the medical field, which suggests a particular tendency in career aspirations amongst Indian students. Few gender differences are reported, although girls (irrespective of ethnicity) are more attracted to medicine and related subjects than boys, while the opposite seems to be the case for STEM subjects, which attract more boys than girls (Elias *et al.*, 2006, Miller *et al.*, 2006). For Chinese and Indian students, available data do not suggest that gender or social class have any significant influences on students’ educational or occupational aspirations.

In a similar vein to the science participation ‘crisis’, aspirations are also multidimensional and can vary by differences in gender, class and/or ethnicity. Research suggests that Black Caribbean girls appear to exert ‘middle class’ aspirations while the boys aspired to sports (Ferber, 2007; Mirza, 1992). Bangladeshi and Pakistani girls seem to view the fields of medicine, accountancy and finance as potential careers, while the boys aspire to degree-educated professions, with no particular fields of interest (Archer, 2003; Dale *et al.*, 2002). Amongst Chinese and Indian students, minimal gender differences are evident in relation to aspirations, with girls unhindered by ‘masculine’ fields of science and mathematics (Archer and Francis, 2007). Although students’ positive attitudes towards school science are declining (Jenkins and Nelson, 2005), minority ethnic students continue to express aspirations towards post-16 education (Strand and Winston, 2008), despite some of them being ‘below average’ achievers at GCSE (DfE, 2010a). Thus, the current study will investigate the apparent mismatches between minority ethnic students’ achievement and their science, education and career aspirations.

Minority ethnic groups’ experiences of science and education: The role of parents

In this final part of the chapter, the role of parents is discussed in relation to minority ethnic students’ educational experiences and aspirations. The family is argued to be significant in shaping individuals’ aspirations (Cheng and Stark, 2002; Garg *et al.* 2002; Jeynes, 2007). The family, notably parents, can provide the foundations for knowledge, ideology, expectations and perceptions of the social world. Garg *et al.* (2002: 88) note that “parents are constant sources of influence on children ...when forming career goals”. Thus, family values, perceptions and experiences can influence students’ aspirations and their interpretation of the social world (Harris and Goodall, 2008). Research evidence suggests that parental support and aspirations for their children can vary amongst minority ethnic groups (Strand, 2007). In this section, the aspirations of Black Caribbean, Muslim (of predominately Bangladeshi and Pakistani ethnic origin), Indian and Chinese parents have for their children are explored in relation education and future careers.

In a study of 16 Black Caribbean parents (mostly single mothers) in England on their aspirations for their children, Nehaul (1999) found education to be highly valued and that many of the parents in her study have expectations for their children to achieve 'good' qualifications (e.g. at GCSE and A-level), such as 'an A in science' (p. 45). Black Caribbean parents appear as active participants in their children's education by providing school-related materials and books, helping with homework and regularly conversing with their children about school. However, even within her small-scale study, Nehaul found Black Caribbean parents have a diverse range of educational and career aspirations for their children, from the generic (and subjective meaning of) 'good' grades to the specific expectations of university education.

According to Wood *et al.* (2007), black students from 'middle class' backgrounds (e.g. parent/s with a university degree) are less likely to be in single-parent families, which are often headed by mothers. Reynolds (2009) argued that the high rate of single-mother families is consistent with the cultural practices of Black Caribbean families, but argues that the negative perception of an absent parent/father as nonparticipants in the lives of their children can be misleading. Reynolds (2009) and Wood *et al.* (2007) found 'middle class' black parents to have greater authority in the education of their children. Black fathers, particularly the second-generation, socialise their sons and daughters in different ways, encouraging sons to adopt 'masculine' traits of outdoor activities, while girls are socialised to have culturally appropriate codes of sexual behaviours (Reynolds, 2005, 2009). Reynolds (2009) found Black Caribbean fathers to be active contributors in family relationships and their children's lives. Similarly, in a study of high-achieving African American men, Maton *et al.* (1998) noted the significance of fathers as role models for their sons and the positive impact of strong family ties, even when they appear to be 'absent'. Interestingly, Smith and Fleming (2006) found that African American mothers hold higher educational aspirations for their daughters than sons, which may reflect wider discourses of mothers favouring daughters (Suitor and Pillemer, 2006). As can be seen, Black Caribbean parents appear to support their children in various ways (which may or may not be educationally related), with the completion of compulsory education generally the minimum achievement expected (Strand, 2007).

Existing studies on British Muslim parents (of predominately Bangladeshi and Pakistani ethnic origin) have noted conflicting findings with regards to their aspirations for their children. On the one hand, Muslim parents appear to recognise the importance of education and thus highly encourage their children (both sons and daughters) to achieve academically (Dale *et al.*, 2002; Kirton, 2009; Tyrer and Ahmad, 2006). On the other hand, some Muslim parents may prevent girls from staying in education post-16 in order to protect 'family honour' (Ahmad, 2007; Dale *et al.*, 2002) and some boys are encouraged to work, rather than study, to ease the family financial difficulties (Salway, 2008).

In general, Muslim parents appear to have high ambitions for their children in pursuing university education and have high hopes for their children in prestigious occupations such as doctors, lawyers and dentists (Kirton, 2009; Tyrer and Ahmad, 2006). Dale *et al.* (2002) suggest that university degrees (or jobs considered professional, *see* Kirton, 2009) can give higher status to the family, giving pride, honour and 'face' for families (and community) with children in higher education and/or with 'respectable' jobs (*see* Zhou, 2005 in the context of Chinese Americans). However, some Muslim parents view educational success as the *only* route for better jobs and careers because they are convinced that they must be better than others to succeed, acknowledging the ethnic penalty and potential racism and discrimination (Dale *et al.* 2002; Tyrer and Ahmand, 2006).

Although Muslim parents are generally supportive of their daughters in education, including university (Archer, 2002a; Tyrer and Ahmad, 2006), some parents have expressed concerns about their daughters being overly westernised and secularised (Ahmad, 2007). Muslim girls attending university can represent a danger in tarnishing the family name/honour if they are seen by fellow members of the family or local ethnic community to engage in activities considered 'unacceptable' or 'bad', such as clubbing or smoking (Ahmad, 2007; Dale *et al.*, 2002). Such precautions may stem from the wider British discourses of university students that tend to associate students with activities like drinking and late-night clubbing (Ahmad, 2007). The fear of 'shaming' the family name, Dale *et al.* (2002) argue, may incite some parents to marry off their daughters as soon as possible (instead of allowing their daughters to participate in post-16 education) to avoid potential harm to the

family name or their daughter's image as an ideal marriage partner. Thus, there appears to be a conflict between Muslim parents' educational aspirations for girls to excel academically and the dangers of 'shame' they fear their daughters could bring to the family by attending university.

Unlike their girls counterparts, Muslim boys appear to be 'pushed' and made to progress in post-compulsory education by their parents (Archer, 2002a), which may reflect cultural expectations of Muslim males to become the breadwinner (Archer, 2003). According to Salway (2008) however, Bangladeshi parents do not always envision their sons pursuing post-16 education. Rather, some parents are keen to encourage their sons to begin working, instead of studying for post-16 qualifications, to ease family financial concerns. Salway explains that the combination of financial difficulties and the relatively 'poor' grades achieved by Bangladeshi boys at school (e.g. GCSE, see DfE, 2010a) may have encouraged parents to see employment as a better/more feasible option than post-16 education. Thus, parents' educational aspirations for their children may be skewed by financial pressures and a realisation that education may be a 'waste of time' (or 'not for me'). As can be seen, Muslim parents appear to have a wide range of, and sometimes conflicting, aspirations for their children.

With regards to Indian students and the role of the family, limited literature is available. In a qualitative study of 125 A-level and university students from minority ethnic backgrounds in England, Springate *et al.* (2008) note the influence of the family in the career choices of Indian students. In particular, certain careers are considered 'socially acceptable' within the local ethnic community, implying parental ambitions or hope for particular professions over others, such as a preference for medicine, dentistry and pharmacy. Indeed, the authors note the significance of 'knock-on' effects, such as knowing someone in a particular field, which can influence or inform aspirations in that field. Such forms of social capital (see Chapter 2) appear most common for Indian students (see Chapter 5), with influences from the family and/or local community networks (Abbas, 2002b; Springate *et al.*, 2008). Available literature seems to suggest that Indian parents have aspirations for their children to excel in 'socially acceptable' careers, such as the medical field.

According to Archer and Francis (2007), British Chinese parents have desires for their children to attend higher education and build professional careers. For instance, some Chinese parents expect their children to be in high status careers such as medicine, law and accountancy, which are considered respectable and financially secure. For other Chinese parents, the completion of a university education is the minimum expected level of achievement for their children as they believe that a university degree will open many opportunities for future employment. Some Chinese parents reflect on their own experiences of education (i.e. in Hong Kong, mainland China), which tended to be “very harsh, with copious amounts of study, and very high levels of discipline and achievement demanded” (Archer and Francis, 2007: 81), when approaching the education of their children in Britain. As a result, some parents ‘push’ their child in education (as they themselves were pushed) with regards to homework or learning objectives. In this case, university is almost an unquestioned (or expected) route for many British Chinese students. In the US context, Zhou (2005) found that the career choices of Chinese Americans are strongly associated with the desire of the family to be (seen as) successful. Within the local ethnic community, family success can be recognised by the educational status of their children as well as financial achievements. In other words, educational achievement can form an integral part of family pride and prestige within the community (c.f. Dale *et al.*, 2002). Similar to Zhou’s study (2005), Archer and Francis (2007) found that British Chinese pupils in their study appear to have internalised the expectations and aspirations of their parents, viewing university as a ‘natural’ process before full-time employment.

As can be seen, minority ethnic parents generally hold aspirations for their children to participate in post-compulsory education (Strand, 2007). Yet, parents from different minority ethnic backgrounds seem to possess a diverse range of expectations for their children. It is within the interest of the current study to explore the views and experiences of minority ethnic pupils with regards to what they think their parents expect them to achieve.

Summary

Chapter 1 presented the rationale for this thesis and illustrated why it is appropriate to investigate the aspirations and views of science amongst 11- to 14-year-old minority ethnic pupils. Although the ‘crisis’ in science participation is multidimensional, there remains disproportionate ethnic differences in the study of science at post-compulsory level: students from British Black Caribbean, Bangladeshi and Pakistani backgrounds are poorly represented; British Chinese and Indian students are proportionally overrepresented (Elias *et al.*, 2006). The 11- to 14-year-old age period has also been identified as the time when students’ interest in science is likely to consolidate.

The current study focuses on the aspirations of minority ethnic students in order to gain an insight into how ideas, aims and ambitions may be formed. Aspirations can be influenced by a range of intertwining factors, such as the family, and can also be shaped in relation to intersecting inequalities such as gender, class and ethnicity. Previous literature on the aspirations of minority ethnic groups has painted an unclear picture. Despite their ‘high’ aspirations towards education, science and/or career, some minority ethnic students’ attainment at GCSE remain ‘below average’ (DfE, 2010a; Strand and Winston, 2008) and they are also relatively rare participants in post-compulsory science education (Elias *et al.*, 2006). Thus, this thesis will explore the apparent discrepancy between minority ethnic students’ achievement and aspirations.

This chapter has raised several important questions in relation to the science participations of minority ethnic students. For instance, why do some minority ethnic students, but not others, successfully translate high aspirations into high educational achievement? Can the discrepancy between aspirations and achievement be explained by ethnic and cultural differences? If so, how does the family interact to bridge the gap between (high) aspirations and (high) achievement? Indeed, how do issues of racism, sexism and social inequalities influence the aspirations and experience of science amongst minority ethnic groups? The questions probed herein are multifaceted, encompassing a range of cultural and social issues (*see* Chapter 3 for the research questions in this study, p.80-81). Chapter 2 will develop the

conceptual framework that will be used in this thesis to try to make sense of the ways in which minority ethnic students aspire to, and identify with, science.

Chapter 2 - Theorising Minority Ethnic Groups and Education

Introduction

In this chapter, the theoretical frameworks guiding the study are examined. Chapter 1 explored the ‘crisis’ in science participation in England and found that there was diversity amongst minority ethnic groups in relation to educational attainment (e.g. at GCSE, *see* DfE, 2010a) and in the study of post-compulsory science (Elias *et al.*, 2006). Some ethnic groups, such as Chinese and Indian, tend to be ‘above average’ attainers at GCSE and are also proportionally overrepresented in the post-compulsory science courses. Others, such as Black Caribbean, Pakistani and Bangladeshi ethnic groups, tend to be ‘below average’ attainers at GCSE and are statistically underrepresented in post-16 science education. Differences in social class, gender and ethnicity appear central in shaping students’ science and educational aspirations and achievements (*see* Chapter 1). This chapter explores some of the complexities surrounding minority ethnic groups and their aspirations in, and identifications with, science by drawing on the works of Pierre Bourdieu (1974, 1977, 1984, 1986, 1990) and sociological theorisations of identity.

The theory of social reproduction, as conceived by Bourdieu, positions the educational system as the main site for re/producing social inequalities. Bourdieu conceptualised the notions of habitus, field and capital to illustrate the significance of social class in producing differences in educational attainments and aspirations. For the current study, the work of Bourdieu provides a lens for exploring the durability and patterned nature of inequalities and differences in minority ethnic groups’ participation in science (*see* Chapter 1). Although Bourdieu’s theory does not explicitly focus on the role of ‘race’/ethnicity, his work has been taken up by researchers who have applied his notions of habitus and/or capital in the context of minority ethnic groups in education (e.g. Archer and Francis, 2006; Blackledge, 2001; Byrne, 2009; Crozier and Davies, 2006; Lareau and Horvat, 1999; Smith, 2007; Yosso, 2005). As the work of Bourdieu has not been extensively applied in the field of science education (exceptions include Adamuti-Trache and Andres, 2008; Archer *et al.*, 2012; Brandt *et al.*, 2010; Elmesky and Tobin, 2005), this study’s

adoption of Bourdieu's theory might offer an alternative viewpoint towards minority ethnic students' educational, science and career aspirations.

The current study is also informed by sociological theorisations of identity, which can be seen to complement Bourdieu's work (Archer and Francis, 2006). The work of Bourdieu focuses on how individuals are socialised (as a result of their socioeconomic status) to interpret and approach the world in specific ways (e.g. what is considered 'normal' and expected for 'people like me') and thus, central to his theory is social class inequality and reproduction. However, as discussed in Chapter 1 in relation to educational achievement (e.g. at GCSE), the significance of social class can also be complicated by ethnicity and gender. Indeed, embodied within the notion of 'people like me' is the notion of identity, particularly the ways in which science is seen by minority ethnic students as a field for 'people like me' (or 'not for me'; Jenkins and Nelson, 2005). As science is typically seen as a field of, and for, the archetypal 'white middle class male' (Baker, 1998; Burnell, 2009; Johnson, 2007; Wakeham, 2008), sociological theorisations of identity can shed light on the ways in which minority ethnic students negotiate inequalities of gender, class and ethnicity in their aspirations to, and identifications with, science (Carlone and Johnson, 2007; Johnson *et al.*, 2011; Marlone and Barabino, 2009; Ong, 2005).

The chapter begins by introducing the thinking tools of Bourdieu (habitus, field and capital) in the educational context and explores how his theory can be applied in the current research. The relevance of sociological theorisations of identity is then discussed in relation to minority ethnic groups, focusing on the notion of 'science identity' and the role of gender and ethnic identities and inequalities in students' experiences of science. A summary of the chapter brings together the theories guiding the current study.

Bourdieu's theory of social reproduction

The work of Pierre Bourdieu (e.g. 1974, 1977, 1984, 1986, 1990) has attracted considerable attention in the sociology of education, particularly his theory of social reproduction. Although Bourdieu's celebrated work was mostly conducted in Algeria (e.g. *Outline of a Theory of Practice*, 1977) and France (e.g. *Distinction*, 1984) in the

1950s and 1960s, his theories continue to be influential in contemporary British educational research (e.g. Ball, 2003), albeit with some refinements (e.g. Reay, 2004b; Skeggs, 2004). For Bourdieu, socioeconomic status is central in the re/production of social privileges, because individuals are socialised with values and resources that are specific to people from their own social class background, which enables their position in society to maintain across generations. In schools, for example, students from ‘middle class’ backgrounds may ‘naturally’ adapt and excel in schools because the education system, according to Bourdieu, reflects and reinforces ‘middle class’ values. For those unfamiliar with the (‘middle class’) school ethos, such as the ‘working class’, education and the classroom may be an alien environment (Bourdieu and Passeron, 1990).

This section explores the notions of habitus, field and capital, which was conceptualised by Bourdieu to explain how social and educational inequalities are produced and reproduced in society. Although Bourdieu’s (1984: 101) formula for social practice was written as $(Habitus \times Capital) + Field = Practice$, it is the components of the formula, rather than the formula itself, which he examined extensively (e.g. Bourdieu, 1984, 1986) since “the terms in the equation do not have any kind of mathematical relationship to one another” (Crossley, 2003: 44, *see also* Warde, 2004). In other words, Bourdieu considers the ways in which individuals interpret, interact with, and participate in the social world as being shaped, influenced and conditioned by the habitus, field and capital. This section begins by explaining Bourdieu’s notions of habitus, field and capital before discussing his theory of social reproduction in the educational context, where his work appears most prominent (e.g. Bourdieu and Passeron, 1990). The applicability of Bourdieu’s theory for the current study is then discussed, highlighting how, despite some shortfalls (Lovell, 2000), his theory can help explain the educational experiences and aspirations of minority ethnic groups (Archer and Francis, 2006).

Understanding Bourdieu’s notions of habitus, field and capital

For Bourdieu, individuals are free and active agents in their thinking and in making their decisions, but such choices are constrained by particular understandings of the world. He developed the notion of habitus in an attempt to overcome the agency-

structure dualism because “it is through the workings of habitus that practice (agency) is linked with capital and field (structure)” (Reay, 2004c: 432). This section explores the key components in Bourdieu’s social reproduction theory: habitus, field and capital.

According to Bourdieu (1977: 86):

The habitus could be considered a subjective but not individual system of internalised structures, schemes of perception, conception and action common to all members of the same group or class and constituting the precondition for all objectification and apperception.

In other words, habitus can be understood as the ways in which individuals internalise a particular understanding of the social world through (specific) experiences which effectively formulate (and govern) one’s way (and boundary) of thinking, acting and approaching the social world. For Bourdieu (1984), habitus can be identified in parallel with social class position, with the ‘middle class’ in possession of a ‘middle class’ habitus, and the ‘working class’ with a ‘working class’ habitus. These classed habituses can inform particular practices (e.g. such as aspirations) as thinkable and ‘normal’ for ‘people like me’ (e.g. ‘working class’ boys aspiring to ‘working class’ jobs, *see* Willis, 1977).

According to Harker (1984: 118), the habitus is “the way a culture is embodied in the individual”, which is developed through long-term occupation of a particular position (e.g. class location) in the social world, and constitutes “a set of dispositions which incline agents to act and react in certain ways” (Thompson, 1991: 12). Bourdieu (1977) notes the dispositions of the habitus as ‘acquired’, ‘structured’, ‘durable’ and ‘transposable’. The habitus is acquired through the repetitive process of learning. Although Bourdieu (1993: 46) acknowledges individual differences, where “no two individual histories are identical so no two individual habituses are identical”, the habitus is inevitably “structured in the sense that they unavoidably reflect the social conditions within which they were acquired” (Thompson, 1991: 12). Thus, individuals from different backgrounds (e.g. social class) will acquire different sets of dispositions. Bourdieu (1984) specifies that individuals brought up

in similar social class backgrounds will gradually adopt, through the process of learning from their social environment, a set of similar dispositions for evaluating and understanding the world (i.e. similar habitus). The habitus is also durable as it is embodied within individuals and operates at the subconscious level. According to Jenkins (2002: 76), “the power of the habitus derives from the thoughtlessness of habit and habituation, rather than consciously learned rules and principles”. This means the habitus functions as ‘second to nature’, constituting a particular way of understanding, thinking, acting and behaving. Lastly, Thompson (1991: 13) notes that “the dispositions [of the habitus] are generative and transposable in the sense that they are capable of generating a multiplicity of practices and perceptions in fields other than those in which they were originally acquired”. In other words, the habitus equips individuals with a set of tools (dispositions) that can be utilised in various sites (or ‘fields’). However, the values of such dispositions are dependent on the field – an interconnected concept to the notion of habitus.

For Bourdieu, the habitus operates within a wider institutional setting called field, which refers to the structure of social relations in which individuals or institutions are located. As Jenkins (2002: 85) notes, a field can be understood as “a structured system of social positions – occupied either by individuals or institutions – the nature of which defines the situation for their occupants”. The field is also understood as ‘a field of forces’ and ‘a field of struggle’ (Harker *et al.*, 1990) because “a field is structured internally in terms of power relations” (Jenkins, 2002: 85). In other words, there can be multiple forms of fields, each with a “different logic and taken-for-granted structure of necessity and relevance which is both the product and producer of the habitus which is specific and appropriate to the field” (Jenkins, 2002: 84). In an interview with Loïc Wacquant, Bourdieu explains that individuals “who dominate in a given field are in a position to make it function to their advantage, but they must always contend with the resistance ... of the dominated” (Wacquant, 1989: 40). In this sense, a field can be seen as the site for struggles over particular forms of capital (as ‘dominant’) (Harker *et al.*, 1990). Fields, therefore, are not fixed and can change, vary and be contested over time (Lareau, 2001). The field of education is examined later in the chapter.

With regards to the habitus, Bourdieu explains that:

The relation between habitus and field operates in two ways. On one side, it is a relation of conditioning: the field structures the habitus, which is the product of the embodiment of the immanent necessity of a field (or of a hierarchically intersecting set of fields). On the other side, it is a relation of knowledge or cognitive construction: habitus contributes to constituting the field as a meaningful world, a world endowed with sense and with value, in which it is worth investing one's energy (Bourdieu and Wacquant, 1992: 127).

While habitus and field appear to influence each other simultaneously, the habitus can be understood as constituting a particular way of life, a set of norms or the thinking and values of the social world. Dispositions of the habitus can vary between social (class) groups, and such dispositions function differently in the various fields. Dispositions (of the habitus) are reinforced over time, through particular forms of experiences and encounters. Such experiences can be located within particular social boundaries (i.e. fields), which Bourdieu argues to be differentiable by social class, through the possession of capital.

As a central aspect of Bourdieu's theory of social reproduction, capital can be understood as resources that can be utilised to position holders of these capital to benefit in one way or another, in various social or economic situations (Bourdieu, 1977). For Bourdieu (1984), capital can constitute the values, knowledge and skills of those in positions of power (e.g. the 'middle class'), which are projected as the norms against which everyone else (e.g. the 'working class') is measured. Social inequality, for Bourdieu, is embedded within social class positions, which produces different types of habitus and capital that enables various advantages (or disadvantages) in social interactions (e.g. in the field of education). For Bourdieu, it is fundamental that:

A capital does not exist and function but in relation to a field: it confers a power over the field, over the materialized or embodied instruments of production or reproduction whose distribution constitutes the very structure of the field and over the regularities and the rules which define the ordinary

functioning of the field and thereby over the profits engendered in this field (Bourdieu in an interview with Wacquant, 1989: 39-40).

Bourdieu applies the analogy of a card game to illustrate the interactions of capital and fields, in which the different sets of skills (to play cards) are dependent on the type of game (i.e. field) being played, with each card 'given' a particular value (capital) in a particular game (Lareau and Horvat, 1999). In short, capital must be understood in relation to fields, as the field governs the 'rule of the game', of what skills (or capital) are valued within a particular game (or field).

In relation to the habitus, capital is the key ingredient for demonstrating the habitus in action. Capital can be seen as working *alongside* the habitus, and it is utilised differently by various habituses. The habitus, in many ways, governs the forms of capital one is expected to acquire and possess. This thesis proposes a contemporary analogy of the relationship between habitus and capital through the components of a computer: the habitus can be seen as the 'motherboard' of a computer, with 'slots' for 'additional hardware', such as 'graphics card' and 'sound card' (i.e. various capital), to complement and improve the overall capacity of the computer. Additional hardware does not 'naturally fit' all types of motherboard, but only to those which are compatible. What Bourdieu would argue, in this scenario, is that the designers of both motherboard (i.e. habitus) and additional hardware (i.e. capital) are of the same manufacturer (i.e. social class), and hence its products are 'naturally' compatible. While not ruling out the possibility of other motherboards being compatible with these additional hardware (i.e. capital), the key message is that certain hardware (i.e. capital) are designed for certain motherboards. Of course, in reality, such processes are more complicated and multifaceted (Skeggs, 2004).

In *The Forms of Capital* (1986), Bourdieu identified four key types of capital which function to privilege certain groups and reproduce social inequalities: economic, social, cultural and symbolic capital. **Economic capital** refers to money and wealth. It is highly rational, with a reified and independent existence, in the form of money (Fowler, 2000). For example, economic capital can be used to buy services or products; it can be accumulated in savings or investments; and it can be lost, such as bankruptcy. According to Bourdieu (1977: 187), **cultural capital** is "the exchange

value that accumulated forms of culture have within the social world". In other words, it is legitimated knowledge (and goods) within a culture/society. Cultural capital can appear in three forms: the 'embodied state', that is, "in the form of long-lasting dispositions of the mind and the body" (Bourdieu, 1986: 243), such as language, accent and ways of walking (Bourdieu, 1990); the 'objectified state', that is, cultural (material) goods or property such as art and paintings; and the 'institutionalised state', such as educational qualifications, where the possession of capital is formally recognised and acknowledged. For example, in contemporary Western society, legitimate cultural capital may include knowledge of da Vinci, Shakespeare or Mozart as such expertise may be acknowledged by (members of) mainstream society as valuable and respected forms of knowledge. Likewise, knowledge not legitimated by mainstream society is, in a sense, 'worthless' within that social boundary (Carter, 2003). It is also important to note, however, that cultural capital is neither set in stone nor universally accepted, either within or across fields (Webb *et al.*, 2002). **Social capital**, for Bourdieu, refers to the connections and networks one can call upon in their effort to achieve a specified goal. According to Bourdieu and Wacquant (1992: 119), "Social capital is the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition". In other words, it infers knowing the 'right' people in the 'right' field at the 'right' time. The 'old boy networks' of the private school and elite university systems, famed for 'string pulling' capacity, are examples of social capital (Fowler, 2000). **Symbolic capital** relates to the legitimate status or prestige within a social boundary and it represents legitimate forms of capital through formal recognitions (Bourdieu, 1990). Put differently, symbolic capital refers to 'valued' forms of economic, cultural and social capital. For example, students who are prefects (or head boys/girls) may have symbolic capital in schools as their role tends to give them some authority (or even advantages) over other students in the school context.

Although capital has no value if it is utilised in a field where it is not recognised, Bourdieu argues that capital garnered from one field can be 'traded' for capital in another, enduring the reproduction of social inequalities. Capital is conceptualised as 'convertible' resources (Bourdieu, 1977). For instance, intellectuals (e.g. lecturers)

may possess significant amounts of cultural and symbolic capital, but much less economic capital in relation to entrepreneurs, who may possess a great deal of economic capital, but not so much cultural (and symbolic) capital. Both lecturer and entrepreneur may be classified as ‘middle class’ by virtue of intellectual or economic ‘power’ – legitimated by educational qualifications or financial resources. Bourdieu views capital to be exchangeable between fields, where capital can be “traded for desired outcomes within their own field or within others” (Webb *et al.*, 2002: 109-110). Economic capital can be ‘converted’ into cultural capital by purchasing access, service or providers of these cultural capital and vice versa. Bourdieu (1977) argues that the possession of one form of capital can ultimately lead to other forms, as capital is ‘convertible’. In due time, the capital individuals acquire will be consistent with people of a similar habitus (or social class background). However, as discussed later in the chapter, the transferrable nature of capital is more complicated than a straightforward transaction (Webb *et al.*, 2002), such that it can be influenced by inequalities of gender and ethnicity (Carter, 2003). As Bourdieu views differences in socioeconomic status as central in the re/production of social inequalities, the next section applies the notions of habitus and capital in the field of education.

Bourdieu and educational inequality

There is a sizable literature within sociology of education that explores Bourdieu’s theory of social class reproduction through his notions of habitus and capital (e.g. Ingram, 2009; Thompson, 2009; Watson *et al.*, 2009). For Bourdieu (1974, 1977), education constitutes a key field within which legitimate culture and knowledge are distributed, and pupils from different social class backgrounds consume and interpret such legitimate culture differently – through different habitus (Bourdieu and Passeron, 1990; Reay, 2001). While state schools are in principle ‘open to all’, successful engagement with the education system is highly dependent on the resources and skills one is able to utilise (Bourdieu and Passeron, 1990). For example, Lareau (2002) found that ‘middle class’ parents would ‘train’ their children how to respond to people with authority (e.g. teachers) and thus installing a sense of ‘entitlement’ in their children’s habitus (*see also* Lareau and Weininger, 2003). Similarly, Vincent and Ball (2007) discussed how the ‘middle class’ child can become a ‘family project’ where parents strategically invest – financially,

emotionally and time – in ‘enrichment activities’ which facilitates social and cultural advantages for their child in education (Ball, 2003). Crozier *et al.* (2008) found that ‘white middle class’ pupils in urban state secondary schools tend to dominate the ‘top sets’ and be selected in the ‘Gifted and Talented’ scheme. Indeed, ‘middle class’ families generally have more leeway than their ‘working class’ counterparts to exercise economic capital and ‘purchase’ various educational privileges for their children (Butler and Robson, 2003; Vincent *et al.*, 2004), such as private tuition (Smyth, 2009) and more importantly, access to popular or high achieving schools, by moving into their catchment areas where houses tend to command premium prices (Gibbons and Machin, 2008; Leech and Campos, 2003). The ‘working class’ child, on the other hand, tends to receive less such support from parents (Lareau, 2002; Reay *et al.*, 2001), which may contribute to their tendency to achieve lower than their ‘middle class’ counterparts in school examinations such as GCSE (DfE, 2010a, *see* Chapter 1). This section explores Bourdieu’s social reproduction theory in the context of education.

Central to Bourdieu’s theory of social reproduction is the claim that schools operate with values typically associated with the ‘middle class’ (Bourdieu and Passeron, 1990). In other words, pupils with a ‘middle class’ habitus are more likely to find the values of the school consistent with that of their own, as the shift from the home – where a child’s habitus is largely informed – to the school, represents a compatible value changeover (Bourdieu and Wacquant, 1992). For instance, Bernstein (cited in Webb *et al.*, 2002) found that ‘middle class’ and ‘working class’ families have different linguistic repertoires, such as the use of languages, vocabularies and communicative expressions. Bernstein stresses that children from less privileged families (e.g. ‘working class’) are more likely to find the language used in the school classroom very different (and unfamiliar) from that in the home, because teachers inhabit an ‘educational habitus’ that derives from the schools, which are built on ‘middle class’ ideologies (Webb *et al.*, 2002). A child from a similar (social class) background to the teachers would make few adjustments in the school, because the child is likely to find the attitudes and values of teachers similar to that of their parents at home. The child, in effect, feels at home. As Bourdieu and Wacquant (1992: 127) comment, “when habitus encounters a social world of which it is the product, it is like a ‘fish in water’: it does not feel the weight of the water and it takes

the world about itself for granted”. Likewise, a child from a less privileged family background (e.g. ‘working class’) is likely to find the values and language used in the classroom very different from that to which is accustomed at home (e.g. Reay, 2001).

For Bourdieu, social/educational inequality is culturally planned, organised and managed by:

Awarding allegedly impartial qualification (which are also largely accepted as such) for socially conditioned aptitudes which is treated as unequal ‘gifts’, it transforms *de facto* inequalities into *de jure* ones and economic and social differences into distinctions of quality, and legitimates the transmission of the cultural heritage (Bourdieu, 1974: 42).

In other words, education is merited as if there is equal access and opportunity for everyone, even though, for Bourdieu, social class plays the determining role in the production of social inequalities. Schools act as facilitators of legitimate knowledge, ability and intelligence but children from ‘working class’ backgrounds are disadvantaged because legitimate values reflect ‘middle class’ values (Bourdieu and Passeron, 1990). Thus, the normative values within the classroom are inherently ‘middle class’. For instance, Bourdieu and Passeron elaborate that ‘middle class’ linguistics represent legitimate forms of linguistic capital, as it is practiced and recognised in institutions such as schools. Such linguistics are characterised by ‘abstraction’, ‘formalism’, ‘intellectualism’ while ‘working class’ linguistics are pathologised as ‘informal’, ‘limited’ and ‘lost for words’. The ‘mismatch’ between the language (and culture) of the home and the schools therefore constitutes a key factor in educational disparity. Those who wish to succeed in education must adapt to a specific form of values (and norms) that is consistent with the school ethos. Education, for Bourdieu, ‘naturalises’ the values of the ‘middle class’ and thus creates unequal access and opportunity for those not ‘naturally’ in possession of dominant values. Bourdieu (1998: 22) concedes that:

The school institution, once thought capable of introducing a form of meritocracy by privileging individual aptitudes over hereditary privileges,

actually tends to establish, through the hidden linkage between scholastic aptitude and cultural heritage, a veritable *state nobility*, whose authority and legitimacy are guaranteed by the academic title.

Thus, children from ‘middle class’ backgrounds, with a ‘middle class’ habitus are likely to find the language used in the classroom similar and compatible with the home. Those with a habitus not consistent with the value of education, namely children from ‘working class’ backgrounds, may encounter incoherent or conflicting values (and understanding of the social world) in relation to the home – which operates within a ‘working class’ habitus. Children from ‘working class’ backgrounds are therefore ill-equipped in education, inhabiting a cultural and linguistic repertoire that is plagued with disadvantages (e.g. Ingram, 2009). For instance, empirical studies have found that ‘working class’ parents tend to command less confidence and depend more on teachers in the education of their children, while ‘middle class’ parents are more active, confident, have more strategic options, and make use of various resources to support their children’s education, such as private tuition and school choices (Ball, 2003; Ball *et al.*, 1995; Lareau, 1987; Reay, 2004a; Skeggs, 1997; Smyth, 2009). Social reproduction occurs when children from privileged backgrounds maintain their privileged positions, and children who lack this privilege remain in dominated positions (Calhoun *et al.*, 1993). As Bourdieu (1986: 214) states, “those who talk of equality of opportunity forget that social games ... are not ‘fair games’”.

For Bourdieu (1984), the habitus conditions (and constrains) the possibilities of individuals, including what is considered ‘normal’ or expected for ‘people like me’ (e.g. Willis, 1977). The habitus – which is classed – has also been argued as shaping (and limiting) one’s identity and aspiration, such as in education (Archer *et al.*, 2007b). According to Reay (2005: 913), “classed thinking and feeling” can limit what is considered to be possible, practical or achievable, creating an imaginary boundary for the development of aspirations and ambitions. For example, Hebson (2009) found ‘white working class’ women to have internalised a particular classed identity which limits aspirations to jobs traditionally considered as ‘working class’, such as ‘factory work’. Similarly, attending university may be ‘normal’ and expected for those with a ‘middle class’ habitus, but a conscious and active decision for the

‘working class’ (Ball *et al.*, 2002b). Archer *et al.* (2007b) found that ‘working class’ young people may struggle to identify or locate themselves with/in higher education as they view university as undesirable, ‘unthinkable’ and ‘not for me’. Thus, classed habitus (and identity) can produce and curtail particular (classed) aspirations (Archer *et al.*, 2007b; Ball, 2003; Ball *et al.*, 2002b; Willis, 1977).

The applicability of Bourdieu’s theory for minority ethnic groups in education

For Bourdieu, social class is the primary force in the re/production of educational inequalities, and gender and ethnicity represent a secondary form of social stratification (McCall, 1992; Lovell, 2000; Reay, 2004c). Yet, Chapter 1 found that the patterns in educational inequalities, such as GCSE attainment (DfE, 2010a), varied across and within the axes of class, gender and ethnicity. For example, the influence of class (e.g. FSM and non-FSM status) on GCSE attainment is only significant within, but not across, ethnic groups (*see* Chapter 1). Although Bourdieu (2001) suggests that the habitus can be gendered, with gendered bodily dispositions, there are little if any references to ‘race’/ethnicity in his theory (Reay, 2004c). His analysis on gender, however, has also been rebuked by some feminists as inadequate and androcentric (e.g. Fowler, 2003, McLeod, 2005). For instance, Bourdieu has been criticised for approaching gender through “standard binaries of masculine domination and female subordination as if these structures are unitary, coherent and unchanged by and in contemporary social life” (McLeod, 2005: 19). Indeed, it has been argued that Bourdieu saw women as “capital-bearing *objects*” rather than “capital-bearing *subjects*” (Lovell, 2000: 21) and women, for Bourdieu, appears to be “repositories” of capital (Lovell, 2000: 22; McNay, 2000: 142) who play “a key role in the maintenance and enhancement of ... capital held by men” (Lovell, 2000: 21). Thus, there are questions over the extent to which Bourdieu’s theory, particularly his notion of capital, can account for inequalities of gender and ethnicity (Adkins and Skeggs, 2004; Archer and Francis, 2006; Lareau and Horvat, 1999; McNay, 2000; Reay, 1995, 2004c; Skeggs, 1997, 2004). For example, Bourdieu’s theory of cultural capital has been criticised for being white-Eurocentric, with ‘white middle class’ culture representing the ‘standard’ and “all other forms and expressions of ‘culture’ are judged in comparison to this ‘norm’” (Yosso, 2005: 76, *see also* Archer and Francis, 2006). In light of the above concerns, this section discusses the

potential purchase of his theory in the current study, which looks into minority ethnic students and their aspirations in, and identifications with, science.

As previously mentioned, Bourdieu (1977) conceptualised capital as ‘convertible’ resources and people with similar (classed) habituses will come to possess similar capital through the conversion of economic, social and cultural capital, even though Bourdieu did not elaborate on the ‘exchange value’ of each capital in the conversion process (Skeggs, 2004), nor did he explore the gendered and racialised nature of capital (Carter, 2003; Dumais, 2002; Reay, 2004b; Yosso, 2005). As Skeggs (2004: 17) thoughtfully notes, “what may have a use-value for one group may not have exchange value”. In other words, some capital may only have (use-)value within one social boundary and hence does not constitute an exchange value for other forms of capital. For example, cultural (or social) capital (produced) within a social boundary (such as a minority ethnic local group) can have a low(er) ‘exchange value’ outside the social boundary and influence of the group. As discussed below, the ‘value’ of capital has been argued to vary by gender and ethnicity.

Scholars have suggested that cultural capital can be seen as gendered as it can function differently for girls and boys (Dumais, 2002; Huppatz, 2009; Lovell, 2000; Reay, 2004b; Skeggs, 2004). In school, boys may possess different (or gendered-specific) forms of cultural capital (that supports academic progress) compared with girls. For instance, for boys to be vocal in the classroom may be recognised as a form of cultural capital, as a sign of confidence or competence. For girls, however, being vocal may not be interpreted in the same way as boys (Francis, 2000a; Morris, 2007). Thus, wider gender discourses appear to structure, govern and influence the value of particular resources and capital possessed by boys and girls (*see also* Reay, 2004b for ‘emotional capital’). Indeed, Dumais (2002) suggests that cultural capital is inherently feminine as participation in, or knowledge of, classical art and music are not popularly associated with (hegemonic) hetero-masculinity. Dumais reasoned that boys who display interest in theatre acting or dancing may be subject to name-calling (such as ‘sissies’) and have their masculinity undermined by their peers. Using the National Education Longitudinal Study (NELS, 1988) survey data in the US, Dumais found girls (and children from ‘high’ socioeconomic backgrounds) as the most likely to participate in ‘elite’ cultural activities such as acting, and argues

that ‘traditional’ gender stereotypes may discourage some boys in various ‘elite’ cultural participations if it was perceived as incompatible with masculine activities (e.g. sports). However, Frank *et al.* (2003) wrote on the diversity of masculinities and explored the experiences of ‘white middle class’ boys who challenged heterosexual masculinity by using their “culturally privileged positions ... [to] disrupt, and rewrite the cultural scripts of masculinity” (Frank *et al.*, 2003: 128). As noted by Skeggs (1997), (gendered) cultural capital is not available to *all* women or men, but may be exclusive to certain (e.g. ‘middle class’) women or men.

In a similar vein, some scholars have argued that Bourdieu’s notion of capital can be racialised (e.g. Byrne, 2009; Yosso, 2005). Lareau and Horvat (1999) argued ‘race’ to be a cultural resource (in the US) because it can influence the nature of social interactions. In their study of parent-teacher communications, Lareau and Horvat found “white parents were privileged in the sense that they began to construct their relationships with the school with more comfort and trust than did the black parents” (p. 44), because black parents appear to be more suspicious about discriminations, as many of them were once subject to legitimate segregation. Similarly, Roscigno and Ainsworth-Darnell (1999), Dunham and Wilson (2007) and Abada and Tenkorang (2009) have argued that the reproduction of cultural capital can be influenced by ‘race’ as well as social class. These authors found, in the context of North America, that Asian (considered as those with Chinese, Japanese and Korean ethnic backgrounds) and white students benefited more from social and cultural capital than black students – with greater ‘returns’, suggesting the racialised nature of capital. Using quantitative data from large-scale national surveys (i.e. National Education Longitudinal Study survey in the US and Ethnic Diversity Survey in Canada), those authors measured students’ cultural and social capital and found the relationship between students’ available capital and their educational achievements varied by ethnic group. All things being equal, black (and Hispanic) students appear to receive less ‘returns’ for their social or cultural capital, signalled by higher drop-out rates, despite coming from similar demographic backgrounds as their Asian and white counterparts. According to Lareau and Horvat (1999: 42), “the rules of the game are built on race-specific interactions” because social and cultural capital appear to be utilised, or recognised, differently when possessed by people of particular racial/ethnic backgrounds.

For example, in a qualitative study of 44 African American pupils from low-income families, Carter (2003) argued that some forms of cultural capital (e.g. knowledge of rap music) may have little value in the mainstream society but is nonetheless valued within a community (or peer group). Such ‘localised’ (or specific) capital (i.e. those with restricted or no exchange value outside a particular domain) can highlight the power of legitimate, dominant capital, as some capital is valued by mainstream society (and thus constitute an exchange value in dominant society) while others are not (Skeggs, 2004). The recognition of capital (predominately cultural capital) as valuable (and therefore legitimate) resources entails a complex process entangled in power relations. In England, Blackledge (2001) found Bangladeshi children are disadvantaged in school because they possess the ‘wrong’ sort of capital. Although Bangladeshi mothers invested heavily in bedtime reading – considered as a source of cultural capital (De Graaf *et al.*, 2000; Sullivan, 2001) – such stories bore no resemblance to British (or Western) cultures and were transmitted in the native language (i.e. Bengali). Blackledge concludes it is not that Bangladeshi children lacked cultural capital, but that their forms of capital are not recognised or valued by the school and teachers. Similarly, Yosso (2005) found the language skills amongst some minority ethnic groups, such as the ability to speak another language other than English, are often ‘unrecognised’ and ‘unacknowledged’ in schools. In light of this, minority ethnic pupils may be disadvantaged in education because they possess the ‘wrong’ types of skills and knowledge that are not often recognised in mainstream British education, such as ‘knowledge in rap music’ and ‘ethnic’ linguistic skills (Blackledge, 2001; Carter, 2003; Yosso, 2005).

However, recent studies have found that some resources (or capital) that may be specific to (particular) minority ethnic groups appear to support upward social mobility and high aspirations. For example, Archer and Francis (2006) found that the discourse of ‘community competitiveness’ to be a form of social capital which promotes high educational aspirations amongst British Chinese families, through the sharing of knowledge amongst Chinese parents within the ethnic community regarding the progress and achievements of their children. Similar suggestions were also proposed by Shah *et al.* (2010) in the context of British Pakistani families and their community networks, using the notion of ‘ethnic capital’. Anthias (2007)

argued that ‘ethnic ties’ can be seen as a form of social capital, even though she was uncertain over the ‘value’ of ethnic social networks in wider society. Yet, Anthias argues that ethnic ties can potentially compensate minority ethnic groups for their (apparent) lack of mainstream capital. Thus, local ethnic networks can potentially generate (and establish) specific norms amongst minority ethnic groups and families (Archer and Francis, 2006; Zhou, 2005, 2009).

Archer and Francis (2006) also explored the potential purchase of the concept of habitus in their study of British Chinese families and found that, to some extent, Bourdieu’s theory can shed light on the ways in which British Chinese parents and children approach education and develop their aspirations. The authors found a discourse of ‘Chinese valuing education’ to be “central to the formation of a diasporic collective habitus in which educational achievement becomes something that ‘people like us’ do” (Archer and Francis, 2006: 43). However, Archer and Francis (2006: 44) note that Bourdieu’s notion of habitus “appears not to offer a complete explanation of racialized educational experiences” because minority ethnic groups, such as British Chinese, continue to suffer from (and negotiate with) other forms of inequalities (such as ‘race’/ethnicity) which could undermine the ‘values’ of the capital available to them (e.g. some capital possessed by minority ethnic groups are not recognised in mainstream society, *see* Yosso, 2005). Thus, in addition to social class differences, inequalities of gender and ‘race’/ethnicity can also contribute and shape what an individual perceives to be possible, achievable and desirable (Archer and Francis, 2006; Reay, 2004c; Skeggs, 1997, 2004).

For Bourdieu (1984), the re/production of educational inequalities reflects the uneven and unequal distribution of capital between those with ‘working class’ and ‘middle class’ habituses. Differences in social class backgrounds thus produce social inequality. Although Bourdieu’s theory is (partially) supported by national statistics in terms of educational achievements (*see* Chapter 1 on the attainments of FSM and non-FSM students), this section has argued that his theory may not be directly applicable as a lens to explain the educational experiences (and inequalities) and aspirations of minority ethnic groups. Capital, for Bourdieu (1977, 1986), is understood as the legitimate, valuable and exchangeable resource in a society that can generate for its holders various social advantages, such as in education.

However, Bourdieu appears to have dismissed the importance and possible values of capital that do not appear to yield or infer any social, cultural, economic or symbolic advantages/privileges (Skeggs, 2004). In other words, Bourdieu seems to have placed little emphasis on ‘non-dominant’ (or ‘non-traditional’) forms of capital (Carter, 2003), which can, nonetheless, generate and circumscribe particular thoughts and aspirations as something ‘people like me’ *do*, or not (Archer and Francis, 2006; Carter, 2003; Shah *et al.*, 2010), even if such capital reinforces inequalities of class, gender and/or ethnicity (Skeggs, 2004).

For the current study, which investigates the science and career aspirations of minority ethnic students, the application of Bourdieuan theory, particularly his notions of habitus and capital, can potentially shed light into the practices, resources, and the ways in which minority ethnic students approach education and develop their aspirations (e.g. what is considered ‘normal’ and expected for ‘people like me’). This thesis also adopts a broader understanding towards the notion of (cultural/social) capital, acknowledging a diverse range of resources, skills and knowledge that may be specific to particular class, gender or ethnic groups (e.g. Reay, 2004a, 2004b; Shah *et al.*, 2010), but yet which can shape or inform aspirations.

Minority ethnic groups and science: Using identity as a theoretical lens

So far, the potential purchase of Bourdieuan theory in understanding minority ethnic groups and their science, educational and career aspirations was discussed in relation to his notions of habitus, field and capital. Yet, Bourdieu’s theory has attracted criticism for its implications of determinism (Jenkins, 1982, 2002). For instance, Nash (1990: 434) argues that the notion of habitus “allows no recognition of self, or choice or action” because Bourdieu’s theory, such as his notion of habitus, was mainly interested in “how the taken for granted practice of socialised individuals is effective in realising the strategic ends of their cultural group” (ibid.). In other words, Bourdieu (1984) seems to have conceptualised individual thinking, acting and behaving as a reflection of their classed habitus and identity (e.g. the normative and expected ways in which ‘people like me’ should interact with the social world). Embedded within the idea of ‘people like me’ is the notion of identity and how individuals come to see themselves as particular people – supported and conditioned

by their habitus and capital, which can also be influenced by social inequalities and identities of gender and ethnicity, as well as class (*see earlier* this chapter).

This section explores sociological theorisations of identity as a lens to understand minority ethnic students and their experiences in, and associations with, science. Unlike Bourdieu (1977), who appears to conceptualise individual practices as unconscious reflections of their classed habitus and thus “there is no adequate discussion of the nature of agents and the self in his work” (Nash, 1990: 434), sociological theorisations of identity can take into consideration the complex interplay between structure and agency, even though the relationship of structure and agency in sociology is highly contested (Sewell, 1992; Shilling, 1992; Willmott, 1999). While the philosophical depth of such debates is beyond the scope of this thesis, the structural stance tends to position individual as ‘string puppets’ with predetermined (and prescribed) options and possibilities (Sewell, 1992). Indeed, Bourdieu has been criticised for viewing individuals (e.g. through classed habitus) as structured beings with little or no freedom and choice (Nash, 1990), even though Reay (2004c: 434-5) explains that “while habitus reflects the social position in which it was constructed, it also carries within it the genesis of new creative responses that are capable of transcending the social conditions in which it was produced”. Agency, on the other hand, refers to the free choices individuals (or institutions) have and can make (Shilling, 1992). This perspective views the individual as in complete control of thoughts and actions, without any constraints. Although such interpretations are vague, the consensual understanding of the structure and agency debate in mainstream sociology tends to position these apparently ‘binary opposites’ as interrelated and interdependent, such as agency (choice and freedom) within structure (social boundaries and constraints) (Sewell, 1992; Shilling, 1992; Willmott, 1999). However, such ‘middle ground’ perspectives are far from being clear, concise and consistent, as the relationship between structure and agency can also be theorised from different philosophical positions (Hays, 1994). Yet, the debates around structure and agency are highly relevant in understanding social identity, particularly the unstable and inconsistent nature of identity negotiation between choice and constraint. For instance, on the one hand, social identity is positioned, or labelled, as a consequence of certain traits (e.g. physical, cultural and ideological). On the other hand, individuals still have the choice in choosing or working towards

particular identities. Indeed, the ‘middle ground’ approach seems to support the notion of identity as choices within boundaries.

In relation to the current study, this section examines the extent to which popular discourses of science as a field for ‘white middle class men’ (Baker, 1998; Burnell, 2009; Johnson, 2007; Wakeham, 2008) influence the ways in which minority ethnic students perceive, construct and identify with science. The concept of identity can complement Bourdieu’s theory in the sense that identities and inequalities of gender, class and ethnicity can be read as an element of the habitus (Archer *et al.*, 2007b), shaping how individuals might negotiate (or be positioned with) an identity in education and science as something that is for ‘people like me’ or not. An outline of sociological theorisations of identity is first presented in relation to ‘race’/ethnicity and gender. The notion of ‘science identity’ is then examined, focusing on how minority ethnic students negotiate their identity in relation to science. This section explores the value of sociological theory of identity as a theoretical lens to understand how minority ethnic pupils construct their educational, science and career aspirations.

Ethnicity, gender and the sociological theorisations of identity

The word identity is probably one of the most ambiguous terms in social science as it has different meanings for different people (Côté, 2006). In short, our identity is simply who we are, but this is complicated in conjunction with the phrase ‘in relation to’ (Hall, 1990; Waters, 1990). According to Jenkins (1996: 2), “Identities are called into question in everyday life, and are established multi-dimensionally”. Identity can refer to the individual, the group or the various aspects of our personas, such as the social, religious, national, regional, political, cultural, ethnic, sexual and gender facets. Some identities may be more dominant than others as our identifications are relationally and contextually located (Lawler, 2008). In other words, individuals construct and assert different identities across space and time. As Hall notes (1990: 222), “Perhaps instead of thinking of identity as an already accomplished fact ... we should think, instead, of identity as a ‘production’, which is never complete, always in process”. In this view, identity is an ongoing development and by no means a final, complete or established fact (Jenkins, 1996; Hall, 1990, 1996).

Although individuals can theoretically proclaim any identity, for such identity to be sustainable, it must also be recognised and ‘approved’ by mainstream society in which the claim was made (Lawler, 2008). In other words, there could be an unlimited range of identities for individuals to ‘pick’, but there are only so many identities one can actually ‘adopt’, for not everyone is ‘qualified’ or ‘approved’ (by mainstream society) as ‘suitable’ candidates (Hall, 1990; Waters, 1999). In this relational perspective, identity ‘disapproved’ in one society (or social boundary) may be received differently in another. Identification is dependent not only on the individual but also on the relationships of the individual to the circumstance in which the individual is identified (Lawler, 2008). Inherent in this view is the issue of power, where identifications in any social circumstances are constituted within a complex power relation (Foucault, 1980). As Hall elaborates in relation to the construction of black identity:

The ways in which black people, black experiences, were positioned and subject-ed in the dominant regimes of representation were the effects of a critical exercise of cultural power and normalisation. Not only, in Said’s ‘Orientalist’ sense, were we constructed as different and other within the categories of knowledge of the West by those regimes. They had the power to make us see and experience *ourselves* as ‘Other’. Every regime of representation is a regime of power formed (Hall, 1990: 225-226).

In his lecture entitled *Negotiating Caribbean Identities*, Hall (1995) discusses the ‘myths of identity’ as he reflects on his own experience towards ‘becoming black’ in Britain, in the midst of the African-American Civil Rights Movement (1955–1968) in the US. Hall (1995: 8) recalled that although “the word ‘black’ had never been uttered in my household or anywhere in Jamaica in my hearing, in my entire youth and adolescence”, he was associated (and also self-recognised) with the identity of black in Britain in the 1960s. As Hall elegantly explains:

Identity is not only a story, a narrative which we tell ourselves about ourselves, it is stories which change with historical circumstances. And identity shifts with the way in which we think and hear them and experience

them. Far from only coming from the still small point of truth inside us, identities actually come from outside, they are the way in which we are recognized and then come to step into the place of the recognitions which others give us. Without the others there is no self, there is no self-recognition (Hall, 1995: 8).

Indeed, in Western countries such as Britain and the US, minority ethnic groups (and particularly ‘visible’ minority ethnic groups) are often recognised not only in terms of ethnic differences, but also by perceived racial and cultural dissimilarities – whether or not these accord with their own ethnic and national identities (Hall, 1990, 1995; Waters, 1990, 1999). For instance, the issue of ‘race’ – ascribed on the basis of perceived physical characteristics – was argued to be an important dimension of all social encounters and as a key ‘marker’ embedded in the individual’s negotiation of social identity (Omi and Winant, 1986; Song, 2003). In her discussion of identity ‘choice’ amongst US immigrants, Waters (1990) found those with ancestors from (predominately white) European countries (e.g. Ireland and Italy) tend to have more freedom to ‘adopt’ and/or ‘drop’ their racial/ethnic identities than those with ancestors from (predominately black) Caribbean and African countries (e.g. Jamaica and Nigeria). Davis (1991) found that Americans with any African ancestry tend to have only the option of a black identity. For instance, West Indian immigrants to the US may find themselves labelled black because the (dominant) white majority may not recognise their (or empower them with the choice of) ethnic identities, such as Jamaicans or Trinidadians. Rather, they are usually seen in racial terms – that is, as black people. According to Song (2003), while many ‘black’ Jamaicans, Trinidadians and Haitians think of themselves in specific ethno-national terms, they are highly aware of being seen as ‘black’ in many social contexts in the US and Britain.

More importantly, Gillborn (2008) argues that the racial identity of black is generally tainted with a ‘low achieving’ identity in wider British educational discourse (*see* Waters, 1999 in the US context). Some authors have argued that teachers have stereotypes of minority ethnic groups, with Black Caribbean (or even Black British) students typically seen as disruptive, aggressive and uninterested in school (Gillborn, 1990; Crozier, 2005; Reynolds, 2006; Wright, 2010; Youdell, 2003). Similarly, students (ascribed) with a Muslim identity are perceived by some teachers as

dangerous and mysterious (Alexander, 2000; Archer, 2003; Crozier and Davies, 2008; Tyrer and Ahmad, 2006), and Chinese (Archer and Francis, 2005, 2007) and Indian (Abbas, 2002a, 2002b) students are generally associated with characteristics such as being quiet, hardworking and obedient. Thus, individuals who are labelled as black, Muslim and Chinese/Indian may be constrained in their ability to express their identity in ways of their choosing (Kibria, 2000).

Gender identity is also complex within the social sciences. Although debates around the relationship between sex and gender are multifaceted and beyond the scope of this thesis (*see* Francis and Skelton, 2005 for review), children ascribed as boys and girls are generally socialised with norms, values and/or practices that are considered ‘appropriate’ for their gender within a society (Paechter, 2007). Butler (1999) critiques but recognises that gender is produced and naturalised in most societies through a ‘heterosexual matrix’ (or ‘heterosexual hegemony’, *see* Butler, 1993), where heterosexuality is socially constructed as the ‘norm’, with masculine characteristics predominantly expressed by males (e.g. Martino, 1999) and feminine characteristics predominantly expressed by females (e.g. Youdell, 2005). For Butler (1999), gender roles are assigned, regulated and disciplined through discourses, which constitute the norms and expectations of people of particular genders. Indeed, the heterosexual matrix can also shape the ways in which certain careers are constructed as appropriate (or desirable) for women and men (e.g. Francis, 2002; Frome *et al.*, 2006; Sikora and Saha, 2009). As Butler elaborates:

“Intelligible” genders are those which in some sense institute and maintain relations of coherence and continuity among sex, gender, sexual practice, and desire ... [which] is produced precisely through the regulatory practices that generate coherent identities through the matrix of coherent gender norms (Butler, 1999: 24).

In *Bodies That Matter*, Butler (1993) elucidates that when newborns are declared as a girl or boy, such naming entails the girl (or boy) is ‘girled’ (or ‘boyed’) and be socialised with gender-appropriate characteristics and what it means to be a girl/woman or a boy/man within a gendered (and most likely heterosexual) society. For Butler (1999), gender can be understood as performative, as something one does

rather than is born with/or as something ‘natural’. West and Zimmerman (1987: 135) explain that “doing gender consists of managing ... occasions so that ... the outcome is seen and seeable in context as gender-appropriate”. In other words, masculinity and femininity are socially performed, controlled and disciplined (Butler, 1999; Francis and Skelton, 2005). Although individuals are not compelled to perform gender through hetero-normative values (e.g. ‘drag queen’ disrupts the heterosexual matrix), perceived inconsistency between the assigned physical body (e.g. as a man or a woman) and the performative gender can result in various social costs, such as discrimination and prejudice (Butler, 1999).

Although identity is conceptualised as fluid and always ‘in process’, it also operates within contextual and relational constraints (Hall, 1990; Jenkins, 1996). The identities of minority ethnic students may encourage or constrain particular educational and career aspirations, as identification with particular jobs or fields of study may represent what ‘people like me’ are expected to do, or not. Since science is popularly seen as a field for ‘white middle class men’ (Baker, 1998; Burnell, 2009; Johnson, 2007; to be discussed next), it would be interesting to explore how minority ethnic students may aspire towards, and identify with, the science field. The following section examines the notion of ‘science identity’.

Understanding ‘science identity’

According to Aikenhead (1996: 8), contemporary science is “a subculture of Western or Euro-American Culture” and hence the acronym WMS, meaning ‘white male science’ or ‘Western modern science’, effectively illustrates the foundation of contemporary science. In other words, modern science was born out of and continues to be dominated by those who are predominantly ‘white middle class men’ (Baker, 1998; Burnell, 2009; Johnson, 2007; Wakeham, 2008), including the popular figures in science such as Isaac Newton, Charles Darwin, Thomas Edison, Albert Einstein and Stephen Hawking. The American Association for the Advancement of Science (AAAS, 1998) emphasised that science and science-related careers have traditionally been viewed as privileges for the elite (e.g. ‘white middle class men’) and thus, certain groups of people, such as women and minority ethnic groups, have been less likely to gain access to valuable scientific knowledge (AAAS, 1998), resulting in

their underrepresentation in science-related careers in the US. As noted by Ong (2005: 596), the “widespread images of ordinary scientists as white men effectively discourage many talented young women and underrepresented minorities from exploring physics [and science] as an option” for further study or a career. If certain subjects or careers (e.g. science) are generally seen to be occupied by people of certain traits (e.g. of a particular gender, social class and ethnicity), then students without those advertised characteristics may experience more challenges in their pursuits of such identities (Carlone and Johnson, 2007; Johnson *et al.*, 2011; Marlone and Barabino, 2009; Ong, 2005). Thus, the popular images of science and scientists as a field populated with ‘white middle class men’ can serve as a powerful ideological tool to normalise certain characteristics expected of potential scientists. Although anyone can work towards an identity (and career) in science by attaining the approved qualifications, such process can vary as individuals navigate through the dimensions of gender, class and ethnic inequalities.

According to Calabrese Barton (1998: 379), within the context of science education, the notion of identity can be understood as “who we think we must be to engage in science”. Previous studies with a focus on science and identity in the US (e.g. Carlone, 2004; Tan and Calabrese Barton, 2007) have tended to apply Lave and Wenger’s (1991) notion of ‘community of practice’ and/or Holland *et al.*’s (2000) ‘figured worlds’ as the theoretical lens for understanding identity development in science. The works of Tan and Calabrese Barton (2007, 2008, 2010) focused on the notion of ‘identities-in-practice’ to account for the role of “environmental factors of the specific community of practice” (Tan and Calabrese Barton, 2008: 49), such as the science classroom. Their case-study analyses of minority ethnic girls in the US, including ‘Melanie’ (2007) and ‘Amelia’ (2008), were based on a year-long ethnography of 6th-grade science lessons. In their work, Tan and Calabrese Barton (2007, 2008) found the identities-in-practice of these girls to have evolved during their 6th-grade science as they successfully ‘authored’ alternative forms of identities-in-practices within the school science community of practice, through different figured worlds within the science classroom (e.g. whole class, small group, individual project and fieldtrip; Calabrese Barton *et al.*, 2008). For example, Melanie began her 6th-grade science as the ‘girl who passes’ (to answer questions) because she was shy and lacked confidence. Through supportive peers in small group work

(figured worlds) and flexible science teaching (community of practice), Melanie developed her identities-in-practice as a ‘confident/funny presenter’ and ‘science talker/storyteller’, as she transformed from being a ‘marginalised’ to a ‘significant’ student in her science class. According to Tan and Calabrese Barton (2007), Melanie exerted agency and created new social spaces within the science classroom (new figured worlds) where she was able to express her science knowledge and participate in science lessons in non-traditional ways, such as through ‘science storytelling’.

Interestingly, the term science or scientific identity was used sparingly in their works (Tan and Calabrese Barton, 2007, 2008, 2010), which may reflect their focus in science classroom interactions, and thus the (shifting) identities of students *in practice*. While out-of-school science activities, such as fieldtrips, were noted as critical for Amelia in her transformation from a ‘problematic’ to an ‘achieving’ student (Tan and Calabrese Barton, 2008), the agencies asserted by Melanie and Amelia were mainly examined within the context of science classroom interactions. External forces (e.g. beyond science classrooms) that could influence students’ identification with science were not fully explored. For example, there are few discussions with regards to the identities and discourses of gender, class or ethnicity in relation to students’ engagement with or perceptions of science. In light of this, the questions of how and why girls like Melanie and Amelia can ‘author’ alternative identities-in-practice could be explored further through the social identities (e.g. gender and ethnicity) and discourses available to students.

In their ‘science identity model’, Carlone and Johnson (2007) propose the key dimensions of ‘science identity’ to be ‘competence, performance and recognition’. That is, for ‘science identity’ to be sustained (within the science classroom, for example), one must be able to demonstrate and perform scientific competence, skills, knowledge and understanding, as well as self-recognition and recognition by others (e.g. science teachers, fellow students) as a ‘science person’ (e.g. Tan and Calabrese Barton, 2007, 2008, 2010). However, Carlone and Johnson (2007) found recognition by others to be challenging amongst their 15 ‘women of color’ participants who were studying science at university, because the scientific field is “mostly white males, along with the institutional and historical meanings of being a scientist (being a white male), complicated their bids for recognition” (p. 1207). In other words, the

sustainability of a performative ‘science identity’ derives from/depends on being recognised by other members of the community, which is more problematic for minority ethnic students due to dominant associations of science with whiteness and maleness (Carlone and Johnson, 2007; Johnson *et al.*, 2011; Marlone and Barabino, 2009; Ong, 2005).

Existing studies continue to report students’ perceptions of scientists and those who excel in science to be associated with the characteristics of socially inept, intelligent, rational, logical, male, middle class, old and white (Burnell, 2009; Carlone, 2004; Losh, 2010; Wyer *et al.* 2010). Losh *et al.* (2008) argue that the science field suffers from an ‘image problem’ as children’s constructions of scientists continue to be heavily gendered (as men) and racialised (as white). Carlone and Johnson (2007: 1207) stress how gender, racial and ethnic identities can “interact with that process of recognition and complicate the development of science identity”. If students’ perceptions of those in science continues to be popularly associated with ‘white middle class men’ (Baker, 1999, Burnell, 2009; Losh *et al.*, 2008), then one ought to question how a ‘science identity’ is perceived and constructed by students who are located within inequalities and identities of gender, class and ‘race’/ethnicity. As Brickhouse *et al.* state:

We need to understand how students are constructed and construct themselves as girls [or boys], as members of a particular racial or ethnic group, as a “good” girl [or boy], as an athlete, and how these identities overlap in important ways with students’ views of scientific identities (Brickhouse *et al.*, 2000: 444).

Thus, an exploration of the discourses and social identities available to students in the current study and their constructions of, perceptions in, and identification with, science may be fruitful. The role of gender, class and ethnicity is now discussed in relation to minority ethnic students’ identifications with science.

Gendered, classed and racialised identity of science

Before the 1920s, women in Europe were deterred from entering science education because they were generally considered as inappropriate (and inadequate) to learn or

teach science (Baker, 1998). In contemporary society, although education is accessible to everyone in most countries, certain fields (e.g. some sciences) continue to be dominated by particular groups (e.g. men), which may reflect the social construction of gender roles and identities (Butler, 1999; Haste, 2004; Paechter, 2007). For instance, Harding (2006) argues that science is socially constructed as rational, objective and masculine, which suggests that an identity/career in science could appear as unattractive (or even ‘inappropriate’) for ‘feminine’ women (and men) (Brotman and Moore, 2008; Ceci and Williams, 2007; Lynch and Nowosenetz, 2009; Roger and Duffield, 2000). As mentioned in Chapter 1, girls and boys generally express different aspirations and perceptions of science, which may reflect their gender socialisation (e.g. Haste, 2004; *see* Chapter 1). For example, Scantlebury and Baker (2007) argue that boys are normally socialised with building blocks (e.g. with *Lego*) and construction activities, which enhances ‘spatial ability and risk-taking skills’ that will aid science learning. Girls, on the other hand, typically play in ‘passive ways’, such as ‘caring for dolls’ that does little to help learning science. In other words, girls may find the scientific activities in school to be inconsistent with their gendered identity and the type of (‘feminised’) activities they typically (and socialised to) participate.

In an ethnographic study of a reform-based science curriculum called *Active Physics*, which was designed to be ‘less traditional’ and more ‘accessible’, ‘inclusive’ and ‘interesting’ to a wider range of students, Carlone (2004) found inconsistency between a ‘good student identity’ and a ‘good science student identity’ amongst some ‘high achieving’ girls (who have previously excelled in science and/or in other subjects), who found the adoption of the latter identity as ‘risky’. Although many students generally enjoyed and were positive towards the reform-based science curriculum, some high achieving girls appeared mystified. The meaning of good student identity for some high achieving girls appeared to entail being a good “listener, memorizer, and recipient of knowledge” while a good science student identity in this *Active Physics* class was interpreted as being “active, hard-worker, problem-solver ... and producer of knowledge” (Carlone, 2004: 404). For some high achieving girls, the switch from being a ‘recipient of knowledge’ to ‘producer of knowledge’ could endanger a good student identity because the qualities of being ‘adventurous’ and ‘active’ – encouraged by the *Active Physics* programme –

appeared inconsistent with the qualities of being ‘quiet’ and ‘recipient’ generally expected of girls with a good student identity (e.g. in the other classes). While the value of science qualifications is recognised for college applications, there appeared to be few incentives for some high achieving girls to risk their good student identity in the reform-based physics programme and perform a good science student identity (Carlone, 2004).

In a study of four 7th grade (age 12-13) African American schoolgirls, Brickhouse *et al.* (2000) highlighted the influence of gender, class and ethnicity in the construction of ‘school science identities’. Of the four girls, who were all capable, keen and interested in science, only ‘Sheela’ – a near perfect student – was recommended for ‘honour tracks’ by her teacher because she was seen to possess the characteristics of a ‘good’ pupil (e.g. she was hard working, self-disciplined and self-motivated) and she was viewed by teachers as academically gifted. ‘Chandra’, although average in terms of ability/grades, also negotiated a ‘smooth’ school science experience due to her ‘middle class’ background. Self-described as a people-person, Chandra was admired by teachers for her ‘sweetness’ and strong communicative skills, despite being seen as ‘lazy’. Of the four girls, Chandra was the only one clearly from a ‘middle class’ family, where she seems most adept at “negotiating school culture in ways that are neither mere compliance nor rebellion” (Brickhouse *et al.*, 2000: 455). Thus, ‘middle class’ Chandra was able to smoothly negotiate between boundaries of the home, school and school science. The other two girls, ‘Sandy’ and ‘Tanisha’, were considered by their teachers as unsuitable candidates to study advance science (e.g. ‘honour tracks’) because they were not recognised to possess the necessary or expected characteristics of ‘good’ or ‘ideal’ science students. Sandy has many out-of-school science experiences but she was only interested in the practical elements of science. While the ‘practical’ identity of Sandy would serve her well in lab experiments that involves physical work, such an identity “does not overlap well with academic talent, and science is not only practical but also an academic subject” (Brickhouse *et al.*, 2000: 455). In this case, Sandy’s ‘practical’ identity had limited her progress in science. Although Tanisha developed a strong interest in rock collection since childhood, she was considered ‘loud’, ‘large’, ‘athletic’ and attention seeking (*see* Morris, 2007) – features which were generally at odds with a ‘good’ female pupil identity (Brickhouse *et al.*, 2000). Thus, although the four girls were all

interested in science, the teachers did not “respond to these identities in value-neutral ways” (Brickhouse *et al.*, 2000: 456). Within the science classroom, ‘middle class’ identity, values and skills, such as being self-disciplined and self-motivated (e.g. Sheela) and/or communicative and negotiative (e.g. Chandra), appeared compatible with the school science ethos (c.f. Bourdieu, 1974, 1977; Bourdieu and Passeron, 1990). The characteristics of being loud (e.g. Tanisha) and practical/manual (non-academic) (e.g. Sandy) – which may reflect ‘working class’ values (e.g. *see* Hartman, 2006) – seemed undesirable in the science classroom (Brickhouse *et al.*, 2000).

Indeed, girls continue to experience difficulties and challenges even if they excel in science education, such as in higher education science. In her qualitative study of 10 female physics undergraduates from minority ethnic backgrounds, Ong (2005: 599) argues that the dominance of white (and male) scientists in the US positions (ethnic) minorities as “representatives of their respective groups, while white scientists effectively speak as individuals”. As Ong explains:

Being white allows the performer – especially a male performer – to speak from positions of neutrality, objectivity and authority [which] are the positions of the accomplished scientist (Ong 2005: 599-600).

In other words, minority ethnic groups and women science students/scientists are disadvantaged by their racial, ethnic and gender backgrounds. Ong notes that ‘lighter-skinned’ women in her study reportedly gained some levels of acceptance in their local physics community, while their ‘darker-skinned’ counterparts reported “a strong sense that their race or ethnicity contributed to their different social treatment by faculty and peers” (Ong, 2005: 604). However, the participants in Ong’s study also agreed that gender was the biggest barrier when negotiating their identity in science.

For example, ‘Elena’, described by Ong (2005) as an ‘uncommonly attractive’, ‘soft, lilting voice’ middle class Latina student, had her scientific competence undermined and ridiculed by male colleagues when she once walked into the laboratory with a mini-skirt. As a result, Elena deliberately changed her appearance to be more ‘masculine’ to improve her ‘credibility’ as a scientist (*see also* Chimba and

Kitzinger, 2010). She wore pants instead of skirt and spoke affirmatively. The ‘need’ for such changes in appearance can be attributed to dominant gender discourses which tend to separate female ‘attractiveness’ and ‘intellect’ into two distinct, and often opposite, categories (Ong, 2005). According to Ong, the story of Elena:

Highlights the enormous thought and energy that traditional outsiders often invest in belonging, or in arranging their bodies and voices to appear to belong (Ong, 2005: 606).

In addition to dress code and ways of speaking, Ong also identified weight gain, minimal make-up and short haircuts as further examples of how women (of minority ethnic backgrounds) attempt to ‘defeminise’ themselves in order to appear (and be accepted) as ‘scientifically competent’. As Ong (2005: 612) concedes, “displays of ‘ordinary’ womanhood and racial/ethnic identities are not readily consistent with displays of their emergent scientist identities”. As can be seen, identities and inequalities of gender and ethnicity can shape and challenge minority ethnic students’ identifications with science.

Furthermore, the popular images of scientists and mathematicians as ‘white middle class men’ are also reinforced by the media, such as through movies, newspapers and television programmes (Chimba and Kitzinger, 2010; Epstein *et al.*, 2010; Flicker, 2003; Mendick *et al.*, 2008). Mendick *et al.* (2008) found mathematicians are often portrayed in the media as people who are white, ‘middle class’, male, heterosexual and occasionally old. Although sometimes presented as ‘natural geniuses’, mathematicians and scientists are also projected as socially awkward or incompetent, erratic and/or with unusual (or unstable) mentality (Losh *et al.*, 2008). Such imagery, including particular clothing, appearance and posture, constitutes what Chimba and Kitzinger (2010) call the ‘Einstein/Darwin stereotype’. For example, in science-fiction movies such as *Back to the Future*, the genius scientist Dr Emmett Brown (or ‘Doc’) resembles the image of popular scientist Albert Einstein (e.g. white, male, old, dressed in long white coat with distinctive hairstyle). In their analysis of UK newspaper reports on leading scientists, Chimba and Kitzinger (2010) found the appearances of male scientists are rarely mentioned, and when it does, it is often brief and resembles an ‘Einstein/Darwin’ stereotype. Female scientists, on the other

hand, tend to be described in greater detail with regards to their appearances (e.g. their fashion sense, physique and hairstyle). On television, they are typically presented as young, sexy and attractive (Chimba and Kitzinger, 2010; Mendick *et al.*, 2008). Chimba and Kitzinger (2010) conclude that women scientists are sexualised while ‘white middle class men’ continue to be seen as the ‘regular’ (and also ‘legitimate’) scientists.

Although social identity is conceptualised as fluid and always ‘in process’, it is also constrained or structured by inequalities and identities of gender, class and ethnicity (Hall, 1990; Jenkins, 1996; Lawler, 2008). Existing literature found a strong stereotype of scientists as ‘white middle class men’, which can reinforce (or impose) the notion of science as ‘not for me’ amongst non-traditional groups. Women, ‘working class’ and minority ethnic scientists/science students appear to have struggled and experienced more challenges in their identifications with science (Brickhouse *et al.*, 2000; Carlone and Johnson, 2007; Johnson *et al.*, 2011; Marlone and Barabino, 2009; Ong, 2005), especially as the media continued to portray ‘white middle class men’ as the face of science (Chimba and Kitzinger, 2010; Mendick *et al.*, 2008). Thus, sociological theorisations of identity can provide a useful lens for understanding how minority ethnic groups may navigate inequalities of gender, class and ethnicity in their construction and development of aspirations and identities in science.

Summary

The current study draws on Bourdieu’s theory of social reproduction and sociological theorisations of identity as the analytic lenses to understand the current pattern and diversity in science participation rates amongst minority ethnic groups. Bourdieu (1977, 1984) argues that differences in social class, which produce classed habitus, can govern the boundaries of what ‘people like me’ are expected to aspire to and achieve, supported by economic, social and cultural capital. Although Bourdieu focuses on the reproduction of class inequality, his theory has been explored by other scholars in relation to re/production of other social inequalities, notably gender and ethnicity (Archer and Francis, 2006; Archer *et al.*, 2007b; Lareau and Horvat, 1999; Reay, 2004b; Skeggs, 2004). As mentioned in Chapter 1, educational achievement

(e.g. at GCSE, *see* DfE, 2010a) varies within and across gender, class and ethnicity. Sociological theorisations of identity can complement the work of Bourdieu by focusing on the extent to which identities and inequalities of gender, class and ethnicity can shape and influence minority ethnic students' identifications with science. For instance, studies have found that the popular images of science/scientists as dominated by 'white middle class men' can make it more challenging for girls and minority ethnic students to associate and identify with science (Carlone and Johnson, 2007; Johnson *et al.*, 2011; Marlone and Barabino, 2009; Ong, 2005). In Bourdieu's language, the scientific field may reside outside the habitus of certain social groups (e.g. girls, the 'working class' and particular minority ethnic groups), constituting an unfamiliar field that may be considered as 'not for me'. Thus, the current study will explore the extent to which Bourdieu's theory and sociological theorisations of identity can provide useful lenses for understanding patterns of science participations and aspirations across different minority ethnic groups.

Chapter 3 – Methodology and methods

Introduction

Chapter 3 presents the methodology and methods for the current study which focuses on minority ethnic pupils (aged 11-14) and their aspirations in, and identifications with, science. As this chapter will discuss, the current study is exploratory and qualitatively informed, drawing primarily on the method of semi-structured interview. Data were gathered between October 2009 and June 2010 in seven London schools and a total of 46 minority ethnic pupils were interviewed, along with five science teachers and one parent. Six focus group discussions and 22 hours of classroom observation with minority ethnic pupils were also conducted to complement the interview data. The aims of the current study are presented below, followed by an outline of the chapter.

Research aims

Building on the literature reviewed in Chapters 1 and 2, important questions were raised with regards to the gap in knowledge concerning the diversity which exists amongst British pupils from Black Caribbean, Pakistani, Bangladeshi, Indian and Chinese backgrounds and their science participation rates. This thesis has three research questions and an overall aim to further our current understandings of minority ethnic groups in relation to their experiences of, aspirations in, and identifications with, science:

1. What is the relationship between educational achievement and minority ethnic pupils' views of and aspirations towards science?
2. To what extent can (i) Bourdieuan theory and (ii) sociological theorisations of identity provide useful lenses for understanding patterns of science aspirations across different ethnic groups?

3. How do cultural identities and inequalities of 'race'/ ethnicity, social class and gender shape minority ethnic pupils' views of and aspirations towards science?

The purpose of this chapter is to describe the methodology used in the current study to address the above research questions. The methodological approach of this thesis is first discussed, which is informed by social constructionism and qualitative research. The rationales for the research methods used are then detailed, followed by a description of the data collection procedure. Next, the chapter explicates the ethical considerations and the role of the researcher in the current study. The approach to data analysis is then outlined before a summary of the chapter is presented.

Methodological approach

The research paradigm of social constructionism and the strategy of qualitative research are explained in this section as the methodological approach taken to address the aim of the current study. Central to this thesis is the notion of aspirations and how minority ethnic students come to develop and consider particular educational or career routes as desirable, thinkable and even 'normal' for 'people like me'. The current study is theoretically informed by Bourdieu's theory of social reproduction and sociological theorisations of identity because the 'crisis' in science participation rates is diverse amongst minority ethnic groups, and such diversity appears to be shaped by inequalities and identities of gender, class and ethnicity (*see* Chapters 1 and 2). This thesis is informed by social constructionism which recognises the role of power in the creation and normalisation of particular knowledge or understandings (Burr, 2003), which is consistent with the theoretical perspectives and research aim of the current study. According to Burr:

Social constructionism insists that we take a critical stance toward our taken-for-granted ways of understanding the world, including ourselves. It invites us to be critical of the idea that our observations of the world unproblematically yield its nature to us, to challenge the view that conventional knowledge is based upon objective, unbiased observation of the world (Burr, 2003:2-3).

The social constructionist research paradigm follows the epistemology of interpretivism, which emphasises subjectivity, as enquiries into the social world are subjectively interpreted by individuals, who are socialised with various preconceptions (Patton, 2002). As Burr (2003: 6) notes, “social constructionism denies that our knowledge is a direct perception of reality ... there can be no such thing as an objective fact”. In opposition to the epistemology of positivism – the “assumption that the nature of the world can be revealed by observation, and that what exists is what we perceive to exist” (ibid.: 3) – social reality is not seen as fixed and stable under the social constructionist paradigm because “the social world is not governed by law-like regularities but is mediated through meanings and human agency” (Snape and Spencer, 2003: 17). For instance, the diversity of cultures and the existence of multiple perspectives mean that any claims of knowledge (or ‘truths’) can only be specific to particular social and historical contexts (Burr, 2003). Social constructionism is thus open to different understandings of social realities. Although individuals or groups can construct particular understandings of and knowledge about the social world, such values tend to be most prominent within the social boundary and influence in which the values are created (Burr, 2003; Pattern, 2002; Snape and Spencer, 2003).

Within each social boundary, however, certain perspectives of the social world may be more prominent than others and the notion of ‘dominant discourse’ can help and refine the methodological approach of the current study. For Foucault (1980), discourse constitutes the particular ways of thinking about the social world that come to be seen as ‘natural’. According to Walshaw (2007: 19), discourse “mean[s] taken-for-granted ‘rules’ that specify what is possible to speak, do and even think, at a particular time...[it] refers to different ways of structuring areas of knowledge and social practice”. In other words, discourse functions as a set of rules, which vary over time and space, and conditions the ways in which people think and act. Discourse can govern what it means to be, for example, a researcher, a parent or a scientist, through particular social constructions that are projected and accepted as ‘natural’, or the way things are (Burr, 2003). However, there can be multiple discourses as the same reference (e.g. a scientist) can have more than one implication. For instance, the discourse of a scientist can be positive, with associated attributes such as intelligent, clever and life-changing people. Yet, the discourse of a scientist can also be

negatively referenced as ‘playing God’, dangerous/mad and obsessive. Thus, the concept of discourse is multifaceted because different groups could construct, follow and accept a certain way of viewing and approaching the social world.

Discourse is never stable or fixed, with alternative and completing discourses. However, not all discourses are ‘equal’ as certain ideologies and practices (or discourses) tend to prevail within a social context (Burr, 2003). The notion of dominant discourse can refer to the accepted or ‘widely-held’ views within a social domain, which Foucault (1980) argues to be produced (and maintained) by those in positions of power. According to Foucault (1980), power is constituted within discourses, through knowledge. For Bourdieu (e.g. 1984, *see* Chapter 2), those from ‘middle class’ backgrounds are likely to be those in positions of power, because it is normally ‘middle class’ values (e.g. ‘middle class’ linguistics) that are recognised (and legitimated) in dominant institutions (e.g. in schools). Thus, dominant discourse represents the ‘normative’ (or legitimate) understandings within a social boundary, at a particular time, space and context. Although social constructionists deny the existence of a single objective reality, the notion of dominant discourse proposes that particular social realities, which are subjective social constructs, can still dominate certain social spaces as a consequence of power and the construction of normality (Burr, 2003; Foucault, 1973, 1980). In other words, certain discourses are dominant in the sense that they are projected as the views of ‘everyone’ (or society), meaning discourses which are less dominant can be marginalised, or even suppressed, if deemed to be inconsistent with the dominant views (Walshaw, 2007). From a social constructionist and interpretive perspective, people from different social backgrounds (e.g. minority ethnic groups) can possess particular values, knowledge and understandings of the social world that may or may not be consistent with the dominant views (Snape and Spencer, 2003).

To address the research questions, this thesis was conducted within the paradigm of social constructionism, which considers social reality as multiple and subjectively constructed. Yet, the notion of dominant discourse suggests that certain social realities (and knowledge) are more durable and prominent than others, facilitated by people in positions of power (e.g. the ‘middle classes’, for Bourdieu, *see* Chapter 2) through the enforcement of particular values as the dominant viewpoints (e.g.

scientists are typically seen/constructed as ‘white middle class men’, *see* Chapter 2). The social worlds of minoritised groups (e.g. those not in positions of power, such as minority ethnic groups) may be marginalised or subordinated in mainstream society. The study reported in this thesis thus explores the views and social worlds of minority ethnic pupils, in relation to their educational, science and career aspirations. In particular, minority ethnic pupils’ experiences and perceptions of the social world (e.g. including what is considered possible or ‘normal’ for ‘people like me’) may reflect their specific ethnic and historical backgrounds.

Following a social constructionist perspective, this thesis adopts a qualitative research strategy, which is concerned with “understanding rather than measuring difference” (Lewis, 2003: 50). Unlike quantitative research, which centralises standardisation, neutrality and generalisable entities, qualitative research tends to focus on a smaller number of people, but in greater detail, with the aim to understand social phenomena from the perspectives of participants (Bogdan and Biklen, 2007; Bryman, 2008; Patton, 2002). Consistent with the social constructionist research paradigm and interpretivism, qualitative research “is not concerned with objective truth, but rather with the truth as the informant perceived it” (Burns, 2000: 388, *see* Bryman, 2008; Snape and Spencer, 2003). The purpose of this exploratory study was to better understand the ways in which minority ethnic students interact with the fields of science and education. The qualitative research methods used in the current study are now discussed.

Research methods

This thesis explores the views of young London students (age 11-14) from Black Caribbean, Pakistani, Bangladeshi, Indian and Chinese ethnic backgrounds (*see* Chapter 1) in relation to their views of, aspirations in, and identifications with, science. This section provides the rationales for the qualitative research methods used which were semi-structured interviews, focus group discussions and classroom observations. The use of different research methods in the current study serves to provide different types of information for the research enquiry. Qualitative research methods generally enable the researcher to have more latitude to probe beyond surface responses (i.e. unlike a questionnaire with ‘tick’ responses to pre-defined

possible ‘answers’), which allow and encourage participants to provide detail and descriptive responses on complex issues, such as participants’ views of, aspirations in, and identifications with, science (Bryman, 2008).

Semi-structured interview was the primary research method, which was used to provide in-depth understandings of 46 minority ethnic pupils’ views of, and aspirations towards, science. Five science teachers and one minority ethnic parent were also interviewed to provide additional data about the minority ethnic pupils who participated in the current study. Six focus group discussions were carried out with 28 pupils from the same minority ethnic background to illuminate the influence of the family on students’ educational and career aspirations and expectations. Science classroom observations (22 hours) were also conducted to complement interview data. Some of the pupils who were individually interviewed (16 out of 46) were later observed in science lessons, which offered an alternative insight into how minority ethnic pupils participated in school science. A background of the methods used in the current study is now presented, explaining how each method was used to address the research questions.

The use of semi-structured interview

According to Bogdan and Biklen (2007: 103), “an interview is a purposeful conversation ... that is directed by one in order to get information from the other”. In general, there are three main approaches to interviewing: structured, unstructured and semi-structured (Bryman, 2008). This section explains why semi-structured interview was the most suitable method for the purpose of the current study.

A structured interview is typically associated with quantitative research, with specific questions and a fixed range of possible responses (i.e. close-ended questions) (Bryman, 2008). For example, in market and opinion surveys, interview questions are addressed to participants using the exact wording and in the exact sequence as it appear on the questionnaire (Hyman *et al.* 2004). Interviewers avoid “influencing the answers of the respondents either by actual suggestion of answers or by conscious or unconscious verbal emphasis or mannerisms” (Hyman *et al.* 2004: 89). Thus, structured interviews aim to produce standardised and objective results, by

conducting each one in exactly the same way (Burns, 2000). For O'Reilly (2005: 120), however, the closed-ended questions commonly exercised in structured (quantitative) interviewing "tend to impose a researcher's own framework of ideas on the participant and restrict the possible range of answers". In other words, the purpose of structured research appears to seek clarification, rather than exploring phenomena, since findings from structured interviews are only significant in numeric and statistical terms (Burns, 2000). Structured interviews, therefore, were considered unsuitable for the current study, since a predefined set of interview questions and a set range of possible answers were not feasible for a study which is exploratory, with 'why' and 'how' questions that required open-ended responses.

Qualitative interview, on the other hand, appeared more appropriate in this thesis, which emphasises the exploration of subjective views and expressions. According to Bryman (2008), qualitative interview encourages 'rambling or going off at tangents', giving insights into what the interviewee regards as relevant and important in response to particular questions. Respondents are encouraged to answer questions using their own words in their own terms (May, 2003). Such an approach raises the possibility of unexpected findings, as participants can potentially lead the interview and develop in detail in areas that they themselves regard as important or significant (Rubin and Rubin, 2005). While a range of qualitative interview strategies have been developed (*see* Flick, 2006, Chapter 13; Gubrium and Holstein, 2002, Chapters 4-8), the two main approaches can broadly be termed as unstructured and semi-structured.

The unstructured interview resembles everyday life conversation, with no specific agenda or aims, as participants respond freely from one or two initial questions probed by the researcher (May, 2003). However, the researcher will be "doing the listening", while the participant will be "doing the talking" (Atkinson, 1998: 32). In such a method, the researcher may enter the 'field' without any planned research questions (and ideally, without any preconceptions), as findings and data gradually emerge through time and interaction (e.g. grounded theory, *see* Glaser and Strauss, 1967). According to Burns (2000: 425), the unstructured interview "is a free-flowing conversation [that] can lead to more of a free association of thoughts and therefore, deeper responses". Burns argues that such a method is well-suited for life history (or story) research, because the researcher can submerge into the social worlds of

participants, hearing the accounts and stories of the respondent, through their uses of language and terms of references (Atkinson, 1998). Although unstructured interviews can offer researchers rich and detailed information, participants are, in effect, controlling the interview direction, which may be less useful in studies with particular aims or topics to investigate (such as the current study). Indeed, as many students in the current study will need to be omitted from their normal class lessons (for a specified period of time, e.g. 45 minutes) in order to participate (*see* 'Data Collection'), the 'free'/'roaming' style of communication encouraged by unstructured interviews is considered infeasible. For the current study, which has specific research aims, the use of unstructured interviews may not yield the appropriate data, as the key research questions in this study may not be adequately addressed by students (if the interviews were 'unguided'). Data collection in this study should prioritise on exploring the particular views of students in relation to specific topics (e.g. such as students' science and career aspirations, *see* Appendix 6).

The semi-structured interview which can be seen as the mediator between structured and unstructured interview was adopted as the main research method for this study. It is the principle research method because the study reported in this thesis examines minority ethnic pupils' subjective views of, aspirations in, and identifications with, science. The semi-structured interview is usually organised with specific topics to be covered (e.g. different themes). It is guided by particular themes, but the exact questions (or sequence of questions) may differ in each interview because the specific questions asked can be in response, or a reaction, to what participants have said. As Rubin and Rubin (2005: 12) note, the semi-structured interview is "invented new each time it occurs". Thus, interview questions can be very broad and flexible, and participants can respond freely under each theme or topic, as the researcher can probe into particular responses for clarifications or further detail (Bryman, 2008). Semi-structured interviews can offer researchers in-depth information to comprehend contextualised views, knowledge and experiences of their participants (Legard *et al.*, 2003).

As detailed later in the chapter (*see* 'The process and challenges of data gathering'), 46 pupils (age 11-14) from Black Caribbean, Pakistani, Bangladeshi, Indian and Chinese ethnic backgrounds were interviewed on their educational, science and

career views and aspirations. Five science teachers of the 46 pupils and one parent were also interviewed in relation to their perceptions and expectations of their student(s)/child.

Although the semi-structured interview enables the researcher to gain useful insights into the subjective views of participants (on particular topics), the exclusive use of the semi-structured interview, as Burns (2000: 426) argues, deprives the researcher “of an ethnographic context in which the informant’s reported perceptions occur, as they [the researcher] are never able to directly observe the informant in their everyday context”. Thus, in recognition of the possible difference between what people say and what people actually do, the current study also adopted the methods of focus group discussion and classroom observation to supplement the information gathered from semi-structured interview. As Burns (2000: 398) continues, “one must look beyond the ‘public’ and ‘official’ versions of reality in order to examine the unacknowledged or tacit understandings as well”. The use of focus group discussions in the current study is discussed next.

The use of focus group discussion

In addition to semi-structured interviews, the current study carried out focus group discussions with pupils from the same minority ethnic background, with the aim to better understand, from the interactions of students, the views and experiences of minority ethnic pupils in relation to their educational, science and career aspirations. The use of focus group discussions were intended to give the researcher a different perspective into pupils’ experiences in science education with a particular focus on the role of the family/ethnic background in shaping pupils’ views of, and aspirations towards, science.

It is useful to begin by noting the ambiguities between ‘group interview’, ‘group discussion’ and ‘focus group’, terms which are sometimes used interchangeably within the social sciences (Barbour, 2007; Bohnsack, 2004; Wilkinson, 2004). For Finch and Lewis (2003: 171), a group interview is “a collection of individual interviews with comments directed solely through the researcher”, while group discussion/focus group “are synergistic in the sense that the group works together ...

to generate data and insights”. In other words, a group interview is similar in nature to that of the individual interview, only with more than one participant at the same time. Focus groups, or group discussions, however, are understood as “a research technique that collects data through group interaction on a topic determined by the researcher” (Morgan, 1997: 6). Kitzinger and Barbour (1999: 4-5) caution that “any group discussion may be called a focus group as long as the researcher is actively encouraging of, and attentive to, the group interaction”. Thus, data in group discussions/focus groups are generated through the interactions of participants, rather than direct communication with the researcher, even though the researcher plays the role of a ‘moderator’ and facilitates the general direction and topics of discussion for participants (Barbour, 2007; Finch and Lewis, 2003; Wilkinson, 2004). In this study, the term ‘focus group discussion’ is used to acknowledge the role of discussion in the production of research data.

Focus group discussions are considered useful in exploratory research (Krueger and Casey, 2009; Vaughn *et al.*, 1996), such as the current study, as participants are encouraged to freely express or discuss their views, opinions and ideas on particular issues, which may be of value to the researcher. According to Morgan (1996: 139), the interaction of participants can “offer valuable data on the extent of consensus and diversity among participants”, and give the researcher some details of “the extent and nature of interviewee’s agreement and disagreement”. Similarly, Flick (2006) notes that through group interaction, the norms within a social group can be ‘validated’ because “participants reveal more of their own frame of reference ... the language they use, the emphasis they give and their general framework of understanding” (Finch and Lewis, 2003: 171; *see also* Kitzinger, 1994). As such, focus group discussions encourage participants to debate, discuss and explain their views and perspectives. Participants are able to clarify and refine their thoughts and opinions through listening to the views and experiences of fellow participants (Kitzinger, 1994; Lewis, 1992; Stewart *et al.*, 2006). Thus, focus group discussions produce data that draw primarily on the interactions of participants. Individuals can express personal viewpoints but may also respond and reflect on the opinions of others.

Although Krueger and Casey (2009) suggest that the participants in a focus group discussion should share some form of commonality (such as occupation, age, gender

and/or ethnicity), because participants from comparable backgrounds may be more at ease with each other, some variations amongst the participants could also be the source of ‘interesting’ discussions, as participants can define and articulate their own position against the views of others (Finch and Lewis, 2003). Stewart *et al.* (2006) also cautioned that the researcher may have considerably less control in a focus group discussion than in an interview, because the interactions amongst the participants may drive the discussion away from the focus of the research. Yet, such divergence may also shed light on the issues the participants regard as significant, which the researcher can probe at a later stage, such as by interview (Krueger and Casey, 2009). As a ‘rule of thumb’, the size of a focus group discussion was suggested to be around 4-6 participants, with 3 focus group discussions recommended for each subgroup in order for data to reach saturation (Krueger and Casey, 2009). In the current study, the case for data saturation was considered less obligatory because the data and insights which arose from focus group discussions were later probed in semi-structured interviews with pupils. Indeed, the number of focus group discussions should be based on the purpose of the study rather than a particular frequency (Vaughn *et al.*, 1996).

In the current study, six focus group discussions were conducted with pupils from the same minority ethnic background and from the same school (for practical reasons; *see* ‘The process and challenges of data gathering’). Focus group discussion was used as a means to explore how pupils from the same minority ethnic background may share similar or different experiences in relation to their science education and the expectations and aspirations of their parents. In this study, the use of focus group discussion had shed light into the role of family members in shaping minority ethnic pupils’ educational and career ambitions. For instance, the researcher was able to gain a richer insight into the significance of the minority ethnic family in shaping particular aspirations and expectations, as pupils shared experiences and debated cultural discourses within the groups (e.g. *see* Chapter 6 on pupils’ discussion of parental expectations). The next section discusses the use of classroom observation in this study.

The use of classroom observation

Science classroom observations were carried out to complement the data garnered about some of the minority ethnic pupils who had been individually interviewed (i.e. the ‘participating pupils’). Observation focused on the interactions of these participating pupils within science classrooms, such as with teacher and fellow pupils, and provided the researcher with some additional insights and data that were not easily obtainable through verbal communication (e.g. *see* Chapter 7 on Fay’s performance of hetero-femininity).

The method of observation in qualitative research is often referenced alongside, or within, the notion of ethnography (Atkinson and Hammersley, 1994). While ethnography is understood as an approach to research, rather than a research method, observation, or participant observation to be precise, constitutes the foundation of ethnographic enquiries. According to Jorgensen (1989: 15), “participant observation seeks to uncover, make accessible and reveal the meanings (realities) people use to make sense out of their daily lives”. As Jorgensen (1989: 12) elaborates, “through participant observation, it is possible to describe what goes on, who or what is involved, when and where things happen, how they occur, and why – at least from standpoint of participants – things happen as they do in particular situations”. Participant observation is not dependent on what is said, but rather, on what is seen, as interpreted by the researcher (Patton, 2002). Observations, therefore, are “powerful tools for gaining insight into situations” (Cohen *et al.*, 2000: 315).

According to DeWalt and DeWalt (2001: 18), participant observation is “a method that combines two somewhat different processes”, namely that of ‘participation’ and ‘observation’. Gold (1958) and Spradley (1980) identified different types, or degrees of participation in observational research. At one end of the spectrum, ‘complete participation’ (or ‘complete participant’ in Gold’s terminology) is when “the ethnographer is or becomes a member of the group that is being studied” (DeWalt and DeWalt, 2001: 20). In this technique, the researcher “lives as much as possible with, and in the same manner as, the individuals being investigated” (Burns, 2000: 405). In other words, the researcher submerges into the social worlds of participants with the aim to become part of the ‘community’ under research (Flick, 2006). At the

other end of the spectrum, ‘passive participation’ (or ‘complete observer’) means the researcher adopts a non-participatory role, who “looks at the scene, literally or figuratively, through a one-way mirror” (Bogdan and Biklen, 2007: 91). In such ‘non-participant’ observation, the researcher does not interfere with the social event under observation. Theoretically, the researcher is ‘invisible’ to those under observation. Alder and Alder (1994) note that most observational research tends to operate between these extremes.

For the current study, the type of participant observation adopted can be compared to Spradley’s notion of ‘moderate participation’ (or Gold’s ‘observer-as-participant’), which acknowledges the presence of the researcher in the research site, but who “does not actively participate, or only occasionally interacts, with people in it” (DeWalt and DeWalt, 2001: 20). Although in the current study the researcher did not intend to ‘participate’ in the sense of ‘active participation’, or to have any obvious or deliberate involvements within the social situation that was observed (i.e. science classroom), the sheer presence of the researcher (in the science classroom) would ‘automatically’ mean that the observation had a participatory nature. However, the researcher attempted to be ‘out of sight’ by sitting at the back of science classrooms and the ‘activeness’ of the researcher was kept to a minimum. In response to concerns raised by Flick (2006: 221), who noted the difficulty in observation research to account for “all aspects of a situation ... at the same time”, the current study adopted the technique of ‘semi-structure observation’ (Cohen *et al.*, 2000), as the researcher entered the science classroom with the focus of observing the classroom interactions and communications of participating pupils.

Although the current study could benefit from regular and sustained periods of classroom observation – which can reduce the significance of the researcher’s presence (*see* Reiss, 2000) and enable the researcher to gain richer data into the complex processes of classroom interactions – such an option was not considered feasible for the current study. Nonetheless, the use of science classroom observation enriched the researcher with alternative insights into the ways in which some minority ethnic pupils have participated in school science. The use of observation provided another dimension of data regarding the participating pupils, and supported some aspects of data analysis and interpretation (*see* Chapters 4 and 7). The next

section describes how the data were collected in the current study, which used the three qualitative research methods just discussed.

Data collection

Forty-six minority ethnic pupils (aged 11-14) from seven London ‘schools’ were interviewed. They were studying at four co-educational state secondary schools (35 pupil participants) and three Chinese complementary schools (11 Chinese pupil participants). In addition, six focus group discussions were conducted and 22 hours of science classroom observations were carried out with minority ethnic pupils. Five science teachers and one minority ethnic parent were also interviewed to provide another dimension of data about the pupils. This section details the data collection procedure by describing the context in which the research was conducted, such as the research site and the process of data gathering. The piloting of the pupil interview guideline is first presented below, since semi-structured interview with students was the main research method used in this study.

Piloting student interview

The purpose of piloting the pupil interview guideline was to give the researcher a ‘feel’ of the interview process (e.g. questioning and probing) with minority ethnic young people and how long the interviews were likely to take. The pupil interview guideline, which was informed by previous literature (*see* Chapters 1 and 2) and the research focus (*see* ‘Research aims’), was piloted with three minority ethnic students (from *Barton* – the first school which agreed to participate in this study, *see* ‘Research site’). The structure, wording and sequence of interview questions in the pupil interview guideline were ‘tested’ to see the extent to which students appeared to comprehend the questions asked. The three student pilot interviews lasted between 25 to 45 minutes, which were audio recorded and transcribed verbatim.

The ‘flow’ of the interviews was generally smooth, as the transition from one question to another seemed logical. However, the wording and sequence of some questions, particularly students’ views of science in relation to gender, class and ethnicity (i.e. part 4 in the pupil interview guideline, *see* Appendix 6), were later

revised after the students appeared confused or to have misunderstood some of the questions. For instance, part 4 in the pupil interview guideline initially began by asking students about their ethnic background and their views of science as a domain dominated by white people. However, in the pilot interviews, the students appeared to have ‘stalled’ when these questions were asked (i.e. there were long pauses). Yet, the students responded expressively and fluently when asked about their views of science in relation to gender. As a result, the questions about science and ethnicity were moved to the end of part 4, and the questions about science and gender were relocated to the beginning of the section (i.e. part 4). Similarly, the phrasing of interview questions related to science and social class were also later modified in light of the requests made by students to the researcher for further elaboration or explanation in relation to the notion of class. As the meaning of class appeared to be understood by students in terms of financial background, the questions about science and social class were also asked with reference to the terms ‘rich people’ and ‘poor people’ (in addition to ‘middle class’ and ‘working class’).

Although a final interview guideline was drawn up for minority ethnic pupils (*see* Appendix 6), it is important to restate that the wording and sequence of interview questions in each student interview are never exactly the same (Rubin and Rubin, 2005), since semi-structured interviews constitute a process of knowledge co-construction between researchers and participants.

Research site

This section describes how and why London schools were selected as the main site for recruiting research participants to the study. According to the Office for National Statistics (ONS, 2001), almost half of all minority ethnic people in England reside in London and almost a third of the London population (in 2009, which was 7.5 million) is from minority ethnic backgrounds (ONS, 2009). As a cosmopolitan city with a diverse ethnic population (*see* Owen, 2006), London was considered a suitable location as the study required participants from a range of minority ethnic backgrounds (e.g. those from Black Caribbean, Pakistani, Bangladeshi, Indian and Chinese ethnic backgrounds).

Using public resources such as the ONS and the Department for Education (DfE) websites, state secondary schools in London boroughs known to have a higher population of (specific) minority ethnic groups were identified. For example, schools in the London borough of Ealing were approached as a means to ‘target’ pupils from Indian ethnic backgrounds, even though Black Caribbean, Bangladeshi, Pakistani or Chinese pupils may also have been recruited. Likewise, schools in the London boroughs of Barnet, Hackney and Tower Hamlets were targeted for pupils from Chinese, Black Caribbean and Bangladeshi/Pakistani ethnic backgrounds, respectively. The four state secondary schools which agreed to participate in the current study may be considered as ‘average’ within their respective local authority (LA) in terms of GCSE attainment and school size. As a general indication, the state schools recruited were all within 15% (above and below) of their respective LA GCSE achievement average. Schools considered as ‘exceptionally’ un/successful were not invited to participate because the status of these schools may suggest that the educational experiences and aspirations of its pupils were ‘non-mainstream’ (or even ‘extreme’), even though, admittedly, individual schools vary considerably despite their apparent similarities (e.g. such as GCSE achievements).

Although it would have been ideal to recruit a range of minority ethnic pupils from each participating school, this proved difficult because some groups, such as Chinese pupils, were poorly (or even not) represented at the state schools which agreed to participate. Unlike the other minority ethnic groups in the current study, the British Chinese population tend not to cluster in specific urban areas. Rather, the British Chinese population is geographically dispersed, living in many part of Britain (Dorling and Thomas, 2004). Although ‘Chinatowns’ exist in large metropolitan areas such as London and Manchester, these are primarily areas of commerce and do not constitute large and dense enclaves where British Chinese people actually live (Li, 1994). Three Chinese complementary schools in London were thus recruited through personal contacts as a means to ‘target’ Chinese pupils. It is noted that almost all of the Chinese participants recruited from Chinese complementary schools attended state secondary schools that are considered ‘above average’ within their respective LA.

The seven participating schools could loosely be categorised as ‘inner-city’, ‘urban’ and ‘suburban’ based on school inspection reports (e.g. Ofsted – Office for Standards in Education, Children’s Services and Skills) and/or personal communications with teachers in the schools, and can be taken as a rough ‘indicator’ for the social class of its pupils (e.g. as predominately from ‘middle class’ and/or ‘working class’ backgrounds). In general, ‘inner-city’ and ‘urban’ schools tend to be associated with the terms ‘underachieving’, ‘under-resource’ and ‘overcrowded’ whilst ‘suburban’ schools, situated ‘outside the city’, tend to attract more positive descriptions like ‘high achieving’ (Noden *et al.*, 1998; Tomlinson, 1998). Schools in ‘suburban’ areas tend to be associated with affluent neighbourhoods and those from ‘middle class’ backgrounds. Schools considered as ‘urban’ and ‘inner-city’ tend to align more with the ‘working class’, with ‘urban’ schools generally situated in residential areas of the city and ‘inner-city’ schools located at the hub of town centres. Although such labels or descriptions were by no means fixed or definitive, the differences in school location were hoped to have aided the recruitment of minority ethnic pupils from a range of social class backgrounds, even though minority ethnic groups, irrespective of their socioeconomic status, tend to concentrate in urban areas (ONS, 2009; Tomlinson, 1998). While it would be naive to assume that the location (e.g. ‘inner-city’/‘suburban’) of the schools define the socioeconomic backgrounds of its pupils (e.g. ‘working class’/‘middle class’), the student composition of a school, nonetheless, tends to be made up of pupils who live in and around the catchment area of the school (i.e. geographically close). Pupils from ‘working class’ backgrounds tend to attend schools close to their residence, while distance appeared to be less of a concern amongst ‘middle class’ pupils (Ball *et al.*, 1996; Gewirtz *et al.*, 1994; Reay and Ball, 1997; Reay and Lucey, 2000). However, the socioeconomic status of the minority ethnic pupils in the current study was not assigned based on the school they attended, but through their individual interviews and the details of their parental occupation and education. Below is a short description of the seven schools which participated. The schools were all co-educational and the four state schools were all considered as ‘ethnically diverse’ in their most recent Ofsted reports. Table 3.1 summarises the schools that participated in the current study. The list of minority ethnic pupils recruited for interviews can be found in Appendix 1.

Table 3.1: Schools in the current study

School	School type	London location	Relative GCSE performance within the school's LA
Barton	State co-educational	'Suburban' / 'Urban'	'Below average'
Cranberry	State co-educational	'Urban'	'Average'
Davidson	State co-educational	'Inner City'	'Above average'
Everest	State co-educational	'Inner City'	'Average'
Hakka	Chinese Complementary	'Inner City'	N/A
Lancang	Chinese Complementary	'Urban'	N/A
Yangtze	Chinese Complementary	'Suburban'	N/A

Although *Barton School* is located in the suburbs of London, it is also considered as an 'urban' school by the assistant head teacher because a large proportion of its pupils commute from an urban area outside the school's residential borough. According to Ofsted, the proportion of students eligible for free school meals (FSM) is above the national average, and within their respective LA, Barton is 'below average' in terms of GCSE attainments. Pupils from Black Caribbean, Pakistani, Bangladeshi and Indian ethnic backgrounds were recruited from Barton (*see Appendix 1*).

According to Ofsted, *Cranberry School* is located in an 'urban' area with a high British Indian presence, which is reflected in the student composition. It is an 'ethnically diverse' school that is dominated by British Indian students. While the proportion of students eligible for FSM is above the national average, Cranberry is 'average' in terms of GCSE attainments within their LA. The majority of Indian pupils were recruited from Cranberry (*see Appendix 1*).

Davidson School is considered an 'inner city' school with half of its students from minority ethnic backgrounds. Most pupils live within close proximity of the school. Ofsted notes that the socioeconomic backgrounds of its pupils are in line with national averages and that Davidson is 'slightly above' the LA average in terms of GCSE scores. Despite three rounds of invitations, only one pupil participated from Davidson (*see 'The process and challenges of data gathering' and Appendix 1*).

Everest School is located near a London underground station and is considered as an ‘inner-city’ school. Although Everest has a large minority ethnic population and a ‘high rate’ of FSM pupils, the school is ‘average’ within their LA in terms of its GCSE achievements. A number of students from Bangladeshi backgrounds were recruited from Everest (*see* Appendix 1).

Three Chinese complementary schools in London: *Hakka School*, *Lancang School* and *Yangtze School*, were also recruited through personal networks to ‘boost’ the number of Chinese pupils in the current study (*see* Appendix 1). These schools are normally run by Chinese parents, often voluntarily, one day each weekend, as students are taught the Chinese language, such as the spoken dialects of Mandarin and Cantonese. Hakka is situated at a local community centre that is considered as ‘inner-city’. It has around 30 students who vary across all ages (e.g. young children and mature adults). Students aged between 11 and 14 were invited and two Chinese pupils from Hakka were interviewed. Lancang operates at an existing state secondary school on Saturdays and has around 100 students ranging from age 5-18. The secondary school is located in an ‘urban’ area. The majority of students at Lancang were primary school aged children, even though Lancang has revision classes for students studying GCSE or A-level Chinese. Two students were individually interviewed and two focus group discussions were conducted with pupils from Lancang. Yangtze is located in a ‘suburban’ area with around 80 school-aged pupils (age 7-18). It runs in a local community centre and the majority of Chinese pupils in the current study were recruited from Yangtze (*see* Appendix 1).

The process and challenges of data gathering

The section describes the process and challenges of data gathering in the current study. British pupils aged 11-14 from Black Caribbean, Pakistani, Bangladeshi, Indian and Chinese ethnic backgrounds were the main participants in the current study (*see* Chapter 1), as examples of ‘low’ and ‘high’ attainers at GCSE (DfE, 2010a) and participants in post-compulsory science education (Elias *et al.*, 2006). In this study, minority ethnic pupils participated in 46 individual interviews, six focus group discussions (with 28 pupils) and were observed during 22 hours of science classrooms (with 16 pupils who were already interviewed). Five science teachers and

one minority ethnic parent were also interviewed to supplement data gathered from pupil interviews. All interviews and focus group discussions were audio-recorded and later transcribed verbatim (*see* 'Ethical considerations'). As the study is located in the British context, it should be noted that all references to students from Black Caribbean, Pakistani, Bangladeshi, Indian and Chinese backgrounds only refers to minority ethnic pupils in Britain (and in London, to be precise), unless otherwise stated.

The study adopted 'purposeful sampling', which is a selection procedure that is not meant to be representative of a defined population, but rather, to locate particular people for the purpose of the research study (Denzin and Lincoln, 1994; Patton, 2002). The researcher worked with a gatekeeper from each participating school throughout data collection. The gatekeepers from the four state schools were all head of science department, with two also assistant head teachers. The gatekeepers from the three Chinese complementary schools consisted of two headmasters and one voluntary teacher.

Minority ethnic pupils were invited to participate through an information letter and consent form addressed to their parents (*see* Appendix 5). The invitation letters were mainly distributed by the gatekeepers to pupils whom they had identified as eligible (i.e. as matching the age and ethnicity criteria). These criteria were later clarified with participating pupils during their interviews (or focus group discussions). For instance, pupils were asked their age and how they would self-ascribe an ethnic (or cultural) identity. The researcher asked each gatekeeper to recruit between six to ten pupils from Black Caribbean, Pakistani, Bangladeshi, Indian and/or Chinese ethnic backgrounds, which seemed to be a manageable number of students (to recruit) without overburdening the gatekeepers. Although the initial aim was to recruit a range of minority ethnic pupils from each school, practical constraints such as availability and accessibility meant that the number of minority ethnic pupils was not equally recruited in each of the participating schools (*see* Appendix 1).

Indeed, all of the gatekeepers (from state schools) reported difficulty in locating pupils aged 11-14 from the minority ethnic groups identified as potential participants (i.e. Black Caribbean, Bangladeshi, Pakistani, Indian and Chinese), especially when

some of the eligible students (i.e. those matching the age and ethnic criteria) chose not to participate (by not returning a signed parental consent form). In particular, despite multiple attempts by the gatekeeper at Davidson to recruit potential participants, only one minority ethnic pupil was successfully interviewed. Although participating pupils in the current study were ‘randomly’ selected by the gatekeepers, it was anticipated that there might be a teacher/gatekeeper bias in the selection (or exclusion) of particular pupils (e.g. such as the ‘higher’ achieving or ‘better’ behaved) to be interviewed by the researcher. Thus, the researcher stressed the need for a range of pupils (e.g. including those with ‘good’ or ‘bad’ behaviours; ‘high’ or ‘low’ previous achievements) within the age and ethnicity criteria who could offer valuable data to the current study. The researcher did, however, express a preference to gatekeepers for similar numbers of boys and girls (from each minority ethnic group) in the selection process, for the purpose of later analysis into the role of gender.

From the four state schools, 35 pupils aged 11-14 were recruited for interviews, which included 9 Black Caribbean, 9 Bangladeshi, 5 Pakistani, 10 Indian and 2 Chinese pupils. In response to the low number of Chinese pupils recruited from state schools, three Chinese complementary schools were approached to ‘boost’ the number of Chinese pupils, which resulted in 11 more Chinese pupils who were interviewed. In the end, 46 minority ethnic pupils were interviewed about their views of, aspirations in, and identifications with, science, which seemed appropriate for a qualitative and exploratory study which investigates the views and aspirations of minority ethnic pupils towards science and education.

Although a spread of minority ethnic pupils was generally recruited in terms of age, gender and previous educational achievement (*see* Table 3.2 below, Appendix 1 and Chapter 4), the majority of pupils were considered as from a ‘working class’ background. While social class remains an ambiguous category to define (Wright, 2005), minority ethnic pupils in this study who have parent(s) with university education and ‘professional’ careers (e.g. Class 1 or 2 on the NS-SEC scale in the UK, such as ‘department manager’, ‘immigration officer’ and ‘self-employed’) were considered to be from ‘middle class’ backgrounds. Pupils considered from ‘working class’ backgrounds have parent(s) with education up to college level and with

‘manual’ or ‘low-skilled’ occupations (e.g. Class 3 on the NS-SEC scale, such as ‘taxi driver’, ‘shoe factory worker’ and ‘part-time receptionist’). Using these classifications, there were eight ‘middle class’ and 38 ‘working class’ pupils in the study. The lack of rigour in the categorisations of minority ethnic pupils into ‘middle’ or ‘working class’ backgrounds should not be seen as a great concern as the study later (*see* Chapter 6) argues that the notion of social class becomes complicated and perhaps less relevant for minority ethnic groups in England/Britain (Archer 2010, 2011).

The interviews with pupils were conducted on a one-to-one basis, usually in a quiet room within the school (e.g. such as empty classrooms or conference rooms) and lasted an average of 40 minutes. Some interview locations were noisier, such as at the corner of a large hall, due to space limitations, which was the case in the Chinese complementary schools. The student interviews began with general questions concerning their likes and dislikes in and out of school, before enquiring into their (and their parents’) views towards education and career aspirations. Students’ constructions, perceptions and views of science were then probed with particular references to the gendered, classed and ethnicised imagery of science/scientist (*see* Appendix 6 for pupil interview guideline). For clarification purposes, the researcher revisited the key points towards the end of each interview and asked the pupils to summarise their career aspirations and views of science. Most pupils who participated appeared expressive and talkative, with only a handful responding with very short answers. In those cases, the researcher would then rephrase the question before moving on. Pupils were offered the chance to choose their own pseudonyms. Table 3.2 below gives a summary of the minority ethnic pupils recruited for individual interviews (*see* Appendix 1 for full list).

Table 3.2: Summary of pupils recruited for interviews

Ethnicity	Male	Female	Total
Black Caribbean	5	4	9
Pakistani	2	3	5
Bangladeshi	8	1	9
Indian	4	6	10
Chinese	7	6	13
Total	26	20	46

The science teachers of the 35 pupils recruited from state schools were invited to participate in the current study using a similar method to that used with the pupils, through an information letter and consent form. In total, five science teachers: three from Barton, one from Cranberry and one from Everest were interviewed for 45 minutes, on average, in their respective classrooms. The five science teachers taught 22 of the 35 minority ethnic pupils recruited from state schools. Science teacher interviews generally began with broad questions related to their own experiences of science teaching and education. Science teachers were then asked of their views toward and experiences of teaching minority ethnic pupils, as well as their expectations and opinions of the pupils who participated in the current study (*see* Appendix 7 for teacher interview guideline). Data collected from science teachers shed light on teachers' perceptions of minority ethnic pupils and provided another dimension of data about some of the pupils who participated in the current study (*see* Chapters 4 and 8).

Minority ethnic parents were invited to participate after their children had been interviewed, through another information letter and consent form given to pupils to pass onto their parents. Although interviews with the parents of participating pupils were intended to provide additional details of how minority ethnic pupils may formulate their science and career aspirations, there was a very low response rate and only one parent agreed to participate (i.e. Narya – father of Vincy, who attended Cranberry). While language barrier (e.g. Song and Parker, 1995) and the reserved nature of (particular) minority ethnic groups (e.g. British Chinese, *see* Li, 1994) may explain the low take-up amongst some minority ethnic parents, the lack of parents in the current study may also reflect the recruitment method, which depended on pupils to deliver (and return) the invitation letters and consent forms to (and from) parents. Chapter 9 (*see* 'Reflections on the research and further study') discussed how the recruitment technique could be improved in future studies which involve minority ethnic parents. The parental interview guideline (i.e. for Narya) was similar to that for pupils. The interview lasted 40 minutes and was conducted at his home. Although limited, the data gathered from this one parental interview supported the analysis of the role of the family in the facilitation of particular aspirations (*see* Chapter 6).

Although initial attempts were made to observe all the pupils who were interviewed from the four state schools, the researcher ended up with observation data for 16 of the 35 minority ethnic pupils in their science lessons, for a total of 22 hours (*see* Appendix 3). The researcher adopted a pragmatic approach towards classroom observation and some pupils were not observed due to timetable clashes (e.g. observation was made with another set of participated pupils who had science at the same time) and practical issues (e.g. with a limited data gathering period, the researcher prioritised the collection of data through the use of semi-structured interviews rather than classroom observation). In each observation, the researcher arrived five minutes before the lesson began and sat at the back of the science classrooms. Hand-written notes were made during each lesson (n=22 lessons/hours) on the communications and interactions of the 16 minority ethnic pupils, which were typed up as field notes, usually later in the same day (*see* Appendix 9 for samples).

While six focus group discussions were conducted with pupils from the same minority ethnic backgrounds, a number of practical issues shaped the data collection process (Finch and Lewis, 2003). For instance, focus group discussions with minority ethnic pupils were only conducted when there were at least four pupils (who all had permission to participate) from the same minority ethnic background, who were available to participate at the same time, and from the same school. In other words, whether or not a focus group discussion took place was heavily dependent on the availability and accessibility of minority ethnic pupils from each school. Although the gender balance can also influence the flow of focus group discussions, such as the ‘peacock effect’, where men “may have a tendency to speak more frequently and with more authority in groups with women” (Krueger and Casey, 2009: 67), the composition of focus group discussions in this study prioritised the similarity of pupils’ minority ethnic background over gender differences. Thus, of the six focus group discussions conducted, two were single-sex, involving Indian boys and Indian girls (both from Cranberry). The other four focus group discussions were mixed-gendered: one with Black Caribbean pupils (from Barton), one with Pakistani pupils (from Barton) and two with Chinese pupils (both from Lancang). The low number (i.e. only 2, from Everest) of Chinese pupils recruited from the four state schools meant that focus group discussions were only conducted in Chinese complementary schools. Indeed, 10 Chinese pupils (from Lancang) were recruited to participate in

two focus group discussions. Although seven Bangladeshi pupils were individually interviewed in Everest, no focus group discussion was conducted with Bangladeshi pupils. The researcher respected the concerns raised by the gatekeeper over the potential absence of four (or more) pupils from the science class at the same time, particularly since it was nearing the revision lessons and examinations.

As detailed in Appendix 2, 28 minority ethnic pupils from three schools (Barton, Cranberry and Lancang) participated in six focus group discussions, which comprised of one group with Pakistani pupils (n=4, from Barton), one group with Black Caribbean pupils (n=5, from Barton), one group with Indian boys (n=4, from Cranberry); one group with Indian girls (n=5, from Cranberry) and two groups with Chinese pupils (n=10, from Lancang). The pupils in focus group discussions were organised by the gatekeepers, who also arranged empty classrooms or conference rooms for the research to take place. The researcher played the role of facilitator in focus group discussions, which allowed the participants to drive the conversation in the direction of their choice. Pupils were asked to share and discuss their views of science and aspirations for the future, as well as the expectations and ambitions of their parents (*see* Appendix 8 for focus group discussion guideline). The focus group discussions lasted between 40 to 75 minutes. Although 16 (out of 28, all from Barton and Cranberry) pupils were later individually interviewed, the majority of Chinese pupils recruited from Lancang (10 out of 12) only participated in focus group discussions (due to time constraint of the researcher and the participants, as only one pupil could be individually interviewed during lunchtime once a week).

Although the process of data gathering was shaped by a number of practical issues, a range of data were collected for analysis. Most importantly, 46 minority ethnic pupils from Black Caribbean, Bangladeshi, Pakistani, Indian and Chinese backgrounds were interviewed about their science, educational and career aspirations. The next section discusses the issue of ethics for the study, which also frames the ways in which data were gathered.

Ethical considerations

In contemporary social research, the issue of ethics plays a central role in the development of a research project, as it directly relates to the integrity of a piece of research (Bryman, 2008). According to May (2003: 59), “ethics is concerned with the attempt to formulate codes and principles of moral behaviour”. In other words, it is a set of principles, which governs morality and acceptable conduct, to ensure researches are conducted in ‘ethically acceptable’ ways. The current study followed the ethical guidelines as drawn up by the British Sociological Association (BSA, 2002), the British Education Research Association (BERA, 2004) and was also approved by the Research Ethics Committee at King’s College London (Ref: REP(EM)/08/09-67). Although there are no universal guidelines on ethics, the practices of ‘code and consent’, ‘confidentiality’ and ‘trust’ are generally considered as fundamental in social research (Ryen, 2004). This section discusses the ethical considerations for the current study.

According to the BSA (2004), “Participation in sociological research should be based on the freely given informed consent of those studied”. Informed consent is the procedure where individuals choose whether to participate in an investigation, after being explained about the nature and details of the research (Diener and Crandall, 1978). According to Silverman (2004: 271), this means “participation is voluntary” and the participants will understand “how their information will be used, with their consent”. In other words, the nature of the research must be clear and open to the participants, to avoid potential accusations of deception, which is strongly condemned within the social sciences (e.g. BERA, 2002; BSA, 2002). Indeed, dishonesty could tarnish the trust and reputation of the discipline and social researchers (O’Reilly, 2005).

The issues of privacy and confidentiality are also important segments in the ‘codes of ethics’. Westin (1968: 7) defines privacy as “the claim of individuals, groups, or institutions to determine for themselves when, how and to what extent information about them is communicated to others”. Privacy is considered violated in covert research, as participants are not given the opportunity to refuse invasions of their privacy. The lack of informed consent, or the use of deception, also entails privacy

invasion, as participants may reveal information they would not have revealed if the true identity of the researcher was known (Bryman, 2008). Thus, following the BSA (2004) codes of ethics, “the anonymity and privacy of those who participate in the research process should be respected. Personal information concerning research participants should be kept confidential”.

Confidentiality refers to “agreements between persons that limit others’ access to private information” (Sieber 1982: 146). Privacy and confidentiality differ in the sense that the former pertains to persons and the latter pertains to information and data. Participants may agree to reveal certain information to the researcher on the grounds that they remain anonymous as the source of the information. Thus, in social research, the use of pseudonyms is common, where the researcher deliberately modifies certain (‘identifiable’) information to conceal the identities of participants. McNeill and Chapman (2005) note that participants may be ‘more willing’ to discuss private and personal matters when anonymity is guaranteed. In this sense, researchers have the responsibility to safeguard and respect the information provided by participants, including the confidentiality and anonymity of individuals, ensuring participants cannot be identified.

Mindful of the issues mentioned above, all participants in the current study were fully informed of the purpose and procedures of the research. Participants were invited to participate through an information letter about the nature of the study and a consent form (to be signed) which guaranteed their confidentiality and anonymity (*see* Appendix 5). The participating pupils were required to obtain the signed consent of a parent/guardian in order to participate in interviews and/or focus group discussions. Pupils themselves were also given a student version of the information letter and consent form, which they had to sign. Prior to each interview and focus group discussion, participants were reminded that participation was voluntary and that they could refuse to comment or answer any question, without reason. Participants were informed that they could end or leave the interview (or focus group discussion) at any time. Permission to audio-record was gained in written consent forms from parents, and again (orally) before the start of each interview and focus group discussion with the participants. Audio data were transcribed with the names of participants anonymised. For science classroom observations, the researcher recorded

participating pupils' interactions through hand-written notes, which were later written up. As before, the anonymity of participants was protected through the use of pseudonyms. Science teachers were also informed that they could withdraw the presence of the researcher from the classroom at anytime and without explanation. During data collection, no interviews, focus group discussions or classroom observations ended prematurely. In addition to ethical considerations, the status of the researcher can also shape the type of data collected in a qualitative research study, which is now discussed.

Role of the researcher

As previously discussed, this study was located within a research paradigm which considers knowledge as socially constructed. This section examines the role of the researcher in the production of research data with the participants, a stance sometimes referred as reflexivity (Rose, 1997) or positionality (Merriam *et al.*, 2001).

Reflexivity in social research requires:

Critical reflection of how the researcher constructs knowledge from the research process – what sorts of factors influence the researcher's construction of knowledge and how these influences are revealed in the planning, conduct, and writing up of the research (Guillemin and Gullam, 2004: 275).

In other words, although qualitative research methods such as semi-structured interviews often acquire data in the terms and language of participants, a reflexive researcher must also be aware of their own position in the generation of research materials, including “the social origins and coordinates (class, gender, ethnicity, etc.) of the individual researcher” (Bourdieu and Wacquant, 1992: 32). Thus, the data gathered in the current study represents a form of knowledge co-construction, because the researcher cannot collect data from the ‘field’ without interruption, or in its ‘natural’ form (Guillemin and Gullam, 2004; Rapley, 2001; Wilkinson, 1998). The use of semi-structured interviews, focus group discussions and science classroom observations in this thesis had artificially created a ‘research environment’ for

specific forms of knowledge to be produced between the researcher and the participants (e.g. ‘researcher-provoked data’, *see* Silverman, 2004). It is therefore necessary to acknowledge the role of the researcher in the construction (and production) of research data, since the biographies of the researcher can shape and influence the ways in which participants interact with the research(er) (England, 1994; May, 2003; O’Reilly, 2005, Rapley, 2001).

The relationship between the researcher and the participants can loosely be categorised into three types: participants who appear to share a lot in common with the researcher (‘insider identity’), participants who appear to share something in common with the researcher (‘insider-outsider identity’) and participants who appear to share little or nothing in common with the researcher (‘outsider identity’). Merriam *et al.* (2001) provide a concise summary of the advantages and disadvantages of each position:

It has commonly been assumed that being an insider means easy access, the ability to ask more meaningful questions and read non-verbal cues, and most importantly, be able to project a more truthful, authentic understanding of the culture under study. On the other hand, insiders have been accused of being inherently biased, and too close to the culture to be curious enough to raise provocative questions. The insider’s strengths become the outsider’s weaknesses and vice-versa. The outsider’s advantage lies in curiosity with the unfamiliar, the ability to ask taboo questions, and being seen as non-aligned with subgroups thus often getting more information (Merriam *et al.*, 2001: 411).

As can be seen, the status (e.g. as an insider or outsider) of the researcher can potentially influence the types of information shared by participants (Hall, 2004). Although a range of ‘social coordinates’ such as age, gender, social class, ethnicity and education/occupation backgrounds can shape the status of the researcher in relation to those being researched (Bourdieu and Wacquant, 1992; Merriam *et al.*, 2001), the significance of gender and ethnicity in reflexive research are well documented (e.g. Archer, 2002b; Sin, 2007). For example, existing literature has found that girls tend to respond positively towards female researchers and negatively

towards male researchers, particularly on ‘gendered’ topics such as marriage or ‘women’s issues’ (Archer, 2002b; Bhopal, 2010).

Some feminists have proposed that only women should study women in order “to provide an accurate reflection of women’s lives” (Hurtado and Stewart, 1997: 297), as representations of women by male researchers may be subjected to patriarchal bias. However, such a perspective can also be complicated by ‘race’/ethnicity. Mainstream feminist research – which has traditionally been led by white ‘middle class’ females – has been criticised by some black feminist for their lack of emphasis on the racialised experiences of minority ethnic females (Amos and Parmar, 2005; Hill Collins, 2000). Indeed, a number of recent studies made reference to the role of gender *and* ethnicity in data collection, shedding light on the ‘race-of-interviewer’ effect (e.g. Adamson and Donovan, 2002; Hall, 2004; Maylor, 2009; Sin, 2007). Proponents of ‘race-of-interviewer’ effect argued that participants respond differently to researchers who are (perceived to be) of a different ‘race’/ethnic group (Davis, 1997; Davis and Silver, 2003; Sin, 2007). For example, in a study of political attitudes amongst African Americans, Davis (1997) found that when interviewed by white researchers, racial minorities were more sensitive and compliant in their responses. Thus, there seems to be a case for ‘gender and ethnic matching’ between the researcher and those being researched (akin to insider status) as a means to provide data that are ‘more accurate’ (Papadopoulos and Lees, 2002).

However, Rhodes (1994) criticised the assumption that ethnic or gender matching of the researcher and those being researched would necessarily provide ‘more accurate or genuine’ data. Although Rhodes recognised that the researcher’s skin colour and/or gender may influence how participants respond, the author insisted that it would be “erroneous to assume that a qualitative difference necessary implies that one type of account is intrinsically superior to another” (p. 548). Consistent with the social constructionist perspective, Rapley (2001: 318) argued that the “data gained in the specific interview begin to emerge *as just one possible version*, a version that is contingent on the specific local interactional context”. Thus, two researchers can validly produce two different accounts from the same source (e.g. participant), which is uniquely shaped, influenced and constructed by a combination of (accountable and

unaccountable) factors in the moments of data co-construction. The positions of Rhodes (1994) and Rapley (2001) informed the current study.

The researcher in this thesis is a British Chinese male PhD student in his mid-twenties. The participants were mainly boys and girls aged 11-14 from Black Caribbean, Pakistani, Bangladeshi, Indian and Chinese ethnic backgrounds. One Indian parent and five science teachers – from White British, White Other and Black African ethnic backgrounds – were also interviewed. Although Chinese pupils in the current study may share similar experiences with the researcher, such as being a Chinese in Britain, they may only find commonality with the researcher in relation to ethnicity. As cautioned by Song and Parker (1995), perceived (or actual) commonality and difference between the researcher and participants, such as cultural/ethnic identity, can often be unstable and shifting (e.g. Henry, 2003; Sanghera and Thapar-Björkert, 2007). In a similar vein, participants from Black Caribbean, Pakistani, Bangladeshi and Indian ethnic backgrounds may view the researcher as a complete outsider or as a ‘fellow member’ of being a minority ethnic person in Britain (Egharevba, 2001). The issue of age may also be significant. Despite being twice the age of pupil participants, the researcher is comparatively young in relation to many (science) teachers in pupils’ respective schools, which may have encouraged participating pupils to be ‘more relaxed’ or ‘more open’ in their interviews and/or focus group discussions. For instance, at the end of a focus group discussion with Indian girls (from Cranberry), one of the participants told the researcher how she was glad that an adult (who was *not* a teacher or a parent) listened to some of her/their concerns about and experiences in school. In relation to science teacher and parent participants, the status of the researcher was also complex as they could identify (or not) with the researcher in a range of domains such as age, gender, social class, ethnicity and educational background (Merriam *et al.*, 2001). For example, the position of the researcher as a PhD candidate may have been associated by some participants (e.g. teacher, parent) as being ‘middle class’ (Rose, 1997) or even in a ‘position of authority’, which could shape how participants interacted (or not) with the research(er).

Although the identity of being a researcher, and *not* a teacher, may have positively influenced the ways in which minority ethnic pupils communicated with the

researcher, the role *as* a researcher also entailed some form of knowledge or status ‘superiority’. All participants, by *default*, are those being researched, which embodies a ‘subordinate’ position to the researcher in a research study (Bourdieu and Wacquant, 1992). Although the extent to which the status of the researcher (e.g. as a British Chinese male PhD researcher in his mid-twenties from King’s) has shaped the forms of data gathered may never be confidently stated, the current study acknowledges that participants may share different information to the researcher depending on how the participants viewed him and how they wish to be perceived (Merriam *et al.*, 2001; Sin, 2007).

Data analysis

The ways in which research data were managed, organised and analysed in the current study are discussed in this section. Data collected from semi-structured interviews and focus group discussions were audio recorded and later transcribed verbatim with the aid of *ExpressScribe* – a transcription software with slow-motion playback for the ease of the researcher. Field notes from science classroom observation were written in ‘expanded’ or ‘extended’ form (*see* Silverman, 2005: 176-177), with descriptive accounts of classroom interactions of participating pupils in science lessons (*see* Appendix 9). In qualitative research, it is common for research data to be sorted (or coded or indexed) in the initial phase by emerging concepts, themes or ideas, with the researcher ‘moving back and forth’ between the data and analyses to refine (and reconceptualise) various categories (Bogdan and Biklen, 2007; Mason, 2002; Merriam, 1998; Miles and Huberman, 1994; Strauss, 1987). In the current study, data analysis was influenced by the works of Corbin and Strauss (2008), the use of ‘thematic charts’ (Ritchie *et al.*, 2003; Ritchie and Spencer, 2004) and the ‘analysis of discourse’ (Archer and Francis, 2007; Burman and Parker, 1993).

In this thesis, research data were initially coded through the identification of ‘interesting’ and common themes that emerged in the early stages of data collection and analysis. A fellow PhD student was also asked to independently code one pupil interview transcript by ‘interesting’ themes, which was then discussed and compared with the researcher’s own coding of the same transcript, and any differences on the application of codes were debated until a consensus was reached. Most of the initial

themes coded by the fellow PhD student were similar to the researcher's coding, which tended to reflect the questions on the pupil interview guideline (*see* Appendix 6).

In general, the question 'what's going on?' was asked of the data, with initial thoughts and interpretations noted as memos (which was later revisited when concepts or themes were more refined). As an example, various lower-level concepts (Corbin and Strauss, 2008) were identified in the early stages of data analysis from pupil interviews, which included the themes that 'science was for geeky people', 'science was for clever people' and 'science was for hardworking people'. Higher-level concepts in relation to these themes were then developed, for instance, 'pupils' perception of science/scientist'. According to Corbin and Strauss (2008: 52), "lower-level concepts point to, relate to, and provide the detail for the higher-level concept". In other words, higher-level concepts are themes which consist of or are constituted by lower-level concepts. Indeed, subsequent analyses of research data followed the procedure of concept identification, engaging in a process through which the dimensions of concepts (and themes) were refined and/or expanded through the comparison of data.

However, it should be noted that some themes or concepts were 'predetermined' by the research methods employed in the current study. For example, the use of interview guidelines meant that a particular focus was already in place during data collection. For instance, the category of 'parental expectation' was derived (and predetermined) from the literature (*see* Chapter 1) as a theme to be explored in relation to minority ethnic pupils' formation of educational, science and career aspirations. Predetermined themes, however, were also subject to an iterative process of gradual coding refinement, with the themes being revised with emerging research data and coding (Hammersley and Atkinson, 2007). The revised themes eventually constituted the foundation of thematic charts – a matrix table that illustrates all the indexed data from individual sources under the relevant themes (Ritchie *et al.*, 2003).

Although some of the original language (i.e. from transcript data) were maintained, data in thematic charts were summarised by key points in a process comparable to a 'funnel', where concepts became more abstract (Corbin and Strauss, 2008;

Hammersley and Atkinson, 2007; Ritchie *et al.*, 2003). It should be noted, however, that the process of “moving up ... the abstraction ladder” (Miles and Huberman, 1994: 224) was not linear as the researcher moved “both up and down the structure [as] categories are refined, dimensions clarified and explanations are developed” (Spencer *et al.*, 2003: 213). Thus, the ways in which data were summarised and synthesised were iterative, as the themes (and subthemes) and indexed data were continuously revisited for further information and clarification (Corbin and Strauss, 2008; Ritchie *et al.*, 2003).

Applying the above approach, research data in the study were organised using *NVivo* 8, software commonly used for managing qualitative research data. *NVivo* 8 computerises the organisation of data and the comparison of codes through the use of matrices and queries. Although there were concerns that the exclusive of software in data coding and analysis can create a ‘distance’ between the researcher and the data (Barry, 1998), *NVivo* 8 was used in this study primarily as an organisational tool (for a review, see Williams, 2004, for a critique, see Merriam, 1998, p. 166-177). Identified themes and concepts were sorted and refined during and after the process of data collection, with emerging (or recurring) concepts or themes from each set of data noted for further analysis.

These concepts and themes were then analysed discursively by exploring the ways in which minority ethnic pupils were positioned (by themselves and by others) within the fields of science and education (see Burman and Parker, 1993). As mentioned earlier, a Foucauldian understanding of discourse was employed in this thesis, which is concerned with the interplay of power in the creation of dominant or prevailing discourses (Burr, 2003). Foucault’s (1973) analysis of psychiatric and medical discourses illustrated how social norms can be produced and sustained by discourses, as well as shaping and influencing (or even constraining) one’s identity and (possible) ways of thinking and doing within particular discourses. This thesis adopted the approach of an ‘analysis of discourse’, which can be understood as “the identification and examination of different discourses” (Francis, 1999: 301) that “involves identifying and analysing discourses as practices that bear power” (Archer and Francis, 2007: 26). The current study applied Bourdieu’s notions of habitus and capital and the concept of ‘science identity’ (see Chapter 2) to interpret the various

discourses produced within minority ethnic pupils' talk in relation to their construction of, aspirations in, and identifications with, science.

For instance, an egalitarian discourse – the belief that anyone can be anything – was produced during the interviews with some minority ethnic pupils about people who work as scientists. Such views about scientists were shaped through a discourse (e.g. understanding of the world) which promotes equal opportunity and the freedom of aspirations. However, pupils' ability to utilise discourse are also shaped by various social inequalities, such as identities of gender, class and ethnicity. Indeed, as discussed in Chapter 7, some pupils in the current study who articulated egalitarian discourses about people who work in science also drew on popular gendered discourses of science as a field 'for men', and implied that men were clever(er) and thus more competent (than women) to succeed as scientists. The apparent contradictions amongst these pupils who utilised discourses of science as 'for anyone' *and* as 'for men' illustrate the complexity within young people's constructions and interpretations of science and scientists. Indeed, there were different (and sometimes competing) discourses (and understandings) embedded within the same issue (e.g. pupils' perception of science/scientists) as the discourses pupils were able to produce through their talks (e.g. about science) were multiple and even contradictory (*see* Chapter 7). Thus, an analysis of/into the discourses employed by minority ethnic pupils may yield deeper understandings into the ways in which minority ethnic pupils come to see science as for 'people like me' (or not) and how pupils were positioned (by themselves and by others) in relation to the seemingly gendered, classed and racialised milieu of science (e.g. popular discourses of science as for 'white middle class men', *see* Chapters 1 and 2). The analysis of discourse in the current study can shed light on the complexities of power constituted in and through discourses pertaining to science (*see* Chapters 6 and 7).

Summary

This chapter described the overall methodology of the current study, which was informed by social constructionism that recognises the power of discourses in the production and maintenance of socially constructed values, practices and ideologies. This thesis collected data from semi-structured interviews (with 46 pupils, 5 science

teachers and 1 parent), focus group discussions (6 discussions were conducted with 28 pupils) and science classroom observations (with 16 pupils for 22 hours). The main data were 46 semi-structured interviews with Black Caribbean, Pakistani, Bangladeshi, Indian and Chinese pupils (aged 11-14) from seven London schools (4 state co-educational and 3 Chinese complementary schools). The details of data collection, the issues of ethics, the role of the researcher and data analysis in the current study were also discussed in the chapter. The subsequent chapters of this thesis describe the research findings. The following chapter addresses the first research question of the current study, which investigates the relationship between achievement, aspiration and engagement in science. A typology of 'student science engagement' is developed.

Chapter 4 – A typology of ‘student science engagement’

Introduction

This chapter develops a typology of ‘student science engagement’ which maps out the various ways in which minority ethnic students participate and engage in science, drawing on data from 46 interviews with minority ethnic pupils, 22 hours of science classroom observations and five interviews with science teachers. In response to this study’s first research question (*see* Chapter 3), the relationship between students’ educational achievement and their science aspirations was initially investigated. However, it soon became apparent that an additional concept was required in order to express the complex relationship between students’ science achievement and their aspirations, which can operate on parallel tracks. Consequently, the notion of ‘science engagement’, or engagement in science, is proposed in this chapter through a typology of ‘student science engagement’ as a means to ‘map out’ the various ways in which minority ethnic pupils appear to participate in, and associate with, science. As will be discussed, the ‘student science engagement’ typology comprises four related themes (or ‘markers’): ‘science aspiration’, ‘science achievement’, ‘science interest’ and ‘science capital’. Although the typology should be treated as tentative, it provides a useful foundation for later analysis into student’s aspirations in science, such as in Chapter 5, which explores the notion of ‘science capital’ and how particular resources/knowledge related to science may influence pupils’ science aspirations. This chapter begins by introducing the typology of ‘student science engagement’, which has seven ‘types’, before discussing the four ‘markers’ of the typology in detail.

Developing a ‘student science engagement’ typology

This section presents a typology of ‘student science engagement’ which maps out seven different ways in which minority ethnic students in this study engage and participate in science. While Table 4.1 below summarises the shared characteristics that students were categorised with in each ‘type’ of the ‘student science engagement’ typology, it should be noted that the ‘student science engagement’ typology as introduced in this section was developed from the analysis of students’

aspirations, achievement, interest and capital in science. These ‘markers’ (i.e. ‘science achievement’, ‘science aspirations’, ‘science interest’ and ‘science capital’) of the ‘student science engagement’ typology are individually discussed later in the chapter. The ‘student science engagement’ typology is presented first, as the key finding in this chapter.

Although the initial aim of this chapter was to explore how students’ achievement in science may shape their science aspirations, in response to the first research question (*see* Chapter 3), preliminary analysis suggested that aspirations can operate independently from science achievement (DeWitt *et al.*, 2011a). In other words, a high achievement in science does not necessarily correlate with strong science aspirations. For example, as discussed later (*see* ‘The complex relationship between science achievement and science aspiration’), the ratios of students in the study who expressed science-related career aspirations are similar amongst those considered as ‘low’, ‘medium’ and ‘high’ attainers in school science (e.g. by their teachers and/or self-reported grades). Thus, a weak relationship was found between pupils’ aspirations and achievement in science. The ‘student science engagement’ typology as presented in Table 4.1 builds on preliminary analysis of student aspirations and achievement in science, and is conceptualised through thematic coding and charting, drawing on student interview data and existing studies. For example, the ‘markers’ of the typology are also informed by the literature reviewed in Chapters 1 and 2, such as the importance of interest and capital in shaping students’ (science) aspirations and achievement (e.g. Archer and Francis, 2006; Tai *et al.*, 2006). In other words, students were categorised with a value (i.e. ‘low’, ‘medium’ or ‘high’) across the ‘markers’ of science achievement, science interest and science capital. Student were also categorised as either having expressed at least one science-related career aspirations, or only non-science-related career aspirations. The values within which students were allocated (by the researcher) across these four ‘markers’ were then mapped onto a nested table (*see* Appendix 11), and seven analytic ‘types’ (which constitute the ‘student science engagement’ typology) were developed as a means to capture/illustrate some of the shared features amongst students in relation to these ‘markers’.

Table 4.1 below presents seven analytic ‘types’ of the ‘student science engagement’ typology, which are: *low engagement*; *wishful engagement*; *ideological engagement*; *medium engagement*; *engagement without aspiration*; *engagement without interest*; and, *high engagement* (see Appendices 10 and 11). The brief description in Table 4.1 alongside each analytic ‘type’ refers to the shared values (e.g. as ‘low’, ‘medium’ and/or ‘high’) that students (within each ‘type’) were categorised with in relation to the ‘markers’ (e.g. science achievement, science interest and science capital) – which were assigned by the researcher based on available data. For example, students considered to have *high engagement* within the ‘student science engagement’ typology were all categorised as having expressed science-related career aspirations, and with ‘high’ achievement, interest and capital in science. The four ‘markers’ within the ‘student science engagement’ typology (and the categorisation of students with the values of ‘low’, ‘medium’ or ‘high’ in relation to these ‘markers’) are also explored separately in the rest of this chapter.

Table 4.1: ‘Student science engagement’ typology

‘Types’	Brief description
<i>Low engagement</i>	Students express no aspirations to/for science-related careers and have with ‘low’ achievement, interest and capital in science (n=9, mostly Black Caribbean boys and girls)
<i>Wishful engagement</i>	Students express science-related career aspirations, but have ‘low’ achievement, interest and capital in science (n= 6, mostly Bangladeshi boys)
<i>Ideological engagement</i>	Students express science-related career aspirations, with ‘medium’ or ‘high’ science interest and capital, but ‘low’ achievement in science (n=2, one Black Caribbean and one Bangladeshi boy)
<i>Medium engagement</i>	Students express at least one science-related career aspirations, with ‘medium’ achievement, interest and capital in science (n=6, pupils from all five minority ethnic groups represented)
<i>Engagement without aspiration</i>	Students express no aspirations to/for science-related careers, but have ‘medium’/‘high’ achievement, interest and/or capital in science (n=10, mostly Chinese boys and girls)
<i>Engagement without interest</i>	Students express science-related career aspirations, but have ‘low’ interest in science, despite ‘medium’ or ‘high’ achievement and capital in science (n=3, one Black Caribbean and two Indian girls)
<i>High engagement</i>	Students express science-related career aspirations, with ‘high’ achievement, interest and capital in science (n=10, mostly Indian boys and girls)

It is important to appreciate that the seven ‘types’ of ‘student science engagement’ illustrated in Table 4.1 are intended as provisional and neither fixed nor rigid categories. The typology incorporates four key elements or ‘markers’, namely ‘science aspiration’, ‘science achievement’, ‘science interest’ and ‘science capital’ because these themes appear to illustrate minority ethnic students’ views and experiences of science. However, the ‘groups’ (e.g. ‘low’, ‘medium’ and ‘high’) within the four ‘markers’ (i.e. ‘science aspiration’, ‘science achievement’, ‘science interest’ and ‘science capital’) of the typology are subjectively assigned, as explained later in the chapter.

Although the typology is developed as a means to map/explain ‘student science engagement’, it is acknowledged that engagement is a multidimensional construct and a term used in many disciplines with diverse meanings (Appleton *et al.*, 2008; Fredricks *et al.*, 2004). In educational psychology, for instance, students’ educational engagement can often be measured by their ‘efforts invested’ in academic learning (Chang *et al.*, 2007; Newmann, 1992), through motivational, behavioural, emotional and/or cognitive dimensions (Appleton *et al.*, 2006, 2008; Lau and Roeser, 2002; Martin, 2007; Shernoff and Schmidt, 2008). However, Fredricks *et al.* (2004) warn that the multiple definitions of engagement (e.g. within educational psychology) often overlap, complicating the meaning (and measurements) of the term. Similarly, the notion of engagement has also been applied ubiquitously in the science education/communication literature, particularly in the sphere of public engagement (e.g. Neresini and Burchi, 2011; Poliakoff and Webb, 2007; Powell and Colin, 2008). In the current study, the word engagement follows the basic definition in the *Oxford Dictionary of English* (Oxford Dictionaries, 2010), where engagement is “the action of engaging or being engaged”, which can refer to how one “participate[s] or become involved in” something or with someone, such as science/scientists. Thus, the ‘student science engagement’ typology is intended as a means for ‘mapping out’ and capturing the various ways in which minority ethnic pupils participate in and engage with science. A description of each ‘type’ is now presented.

Students categorised with *low engagement* in science have ‘low’ levels of achievement, interest and capital in science, and expressed no aspirations towards science-related careers. From the 46 minority ethnic students in the study, nine

pupils (4 boys and 5 girls) are classified in this category, most of whom were categorised as ‘working class’ (8 out of 9) and students from Black Caribbean backgrounds (5 out of 9). There was also one Pakistani (the only ‘middle class’), one Bangladeshi and two Chinese students with low engagement in science. For example, Gina (12, F, Black Caribbean, Barton) is in Year 8 and expressed aspirations to be a policewoman or a football player. She claims to have lost interest in school science since the decline of practical activities and the increase in textbook reading/work at the end of Year 7. Her reported grades of level 4 for most of her subjects, including science, are considered as ‘low’ for Year 8 pupils by national standards (DCSF, 2002). Although Gina enjoyed sports, particularly football and netball, where she played for the school, she appeared to have little if any resources in, and exposure to, science outside of school. Gina is considered to have *low engagement* in science because she did not appear to have aspirations towards science-related careers and her achievement, interest and capital in science is considered ‘low’.

Wishful engagement in science characterises students who expressed science-related career aspirations, but who seem to have ‘low’ levels of achievement, interest and/or capital in science. There are six pupils in this category: four Bangladeshi boys, one Pakistani girl and one Chinese girl, all from ‘working class’ backgrounds. Amir (14, M, Bangladeshi, Everest), for instance, aspires to be a car engineer and a bank manager. Similar to Gina, Amir said he gradually lost interest in school science because it was repetitive (‘we started to get used to everything’) and boring. According to Aschbacher *et al.* (2010), low achieving students with science-related career aspirations tend to lack social and cultural capital in science. However, Amir seems to have some science capital as he claims to have a ‘Horrible Science’ book and access to the Discovery Channel (*see* later and Chapter 5), even though he is in the ‘bottom set’ for science and his level 5 grade in science is considered ‘low’ for Year 9 pupils (DCSF, 2002).

Students with ***ideological engagement*** in science expressed aspirations towards science-related careers and possessed ‘high’ levels of science capital and science interest. However, similar to those categorised with wishful engagement, they had ‘low’ levels of achievement in science. There was one Black Caribbean ‘middle

class' boy and one Bangladeshi 'working class' boy in this category. Although Jube (11, M, Bangladeshi, Barton) is considered a 'low' achiever in science, with level 3 grades in Year 7 (DCSF, 2002), his interview transcript suggested that he has available to him a range of capital related science. For example, Jube participated in an afterschool science club and he had various experiment kits at home. In school, his science teacher Ms Smith (36, F, White Other, Barton) praises his enthusiasm and interest in science ('He puts so much effort into everything ... he's got the attitude, he keeps going at it, and he will ask questions, specific questions'), a comment which mirrors science classroom observation notes:

Jube seems like an 'ideal' pupil in terms of behaviour and attitude. He asks questions frequently and is generally focused and engaged throughout the lesson ... Jube appears particularly interested in experiments – he continued asking Simon (a trainee teacher) questions during and after an experiment on burning metals (Observation notes, Dec. 3rd, 2009).

As explained later (*see* 'Science aspiration and the influences of gender, class and ethnicity'), although students categorised with *wishful engagement* and *ideological engagement* in science all expressed aspirations towards science-related careers, their science career ambitions may appear unrealistic given their tendency to achieve 'low' grades in science (e.g. *ideological engagement*) and with 'low' science interest and science capital (e.g. *wishful engagement*).

Students with *medium engagement* in science are those who expressed science-related career aspirations and who tended to exhibit 'medium' levels of achievement, interest and/or capital in science. Students in this category can be seen as a 'step-up' from those with *ideological engagement*, particularly in relation to science achievement, as students in this category tended to have 'medium' (or even 'high') levels of achievement in school science. There are six pupils with *medium engagement* in science and with the exception of Bangladeshi, which has two pupils; there is one student from each of the other four other minority ethnic groups. Kyle (14, M, Bangladeshi, Everest) is a Year 9 student with level 6 achievement in science, which may be considered as average, or as a 'medium' attainer (DCSF, 2002). He had ambitions to be an artist, mechanic or electrician and he is considered

to have a ‘medium’ level of science interest because he enjoys doing experiments, working with computers and he even tried a scientific experiment at home after a school demonstration. However, he also finds school science to be boring and repetitive, with too much writing. Kyle appears to have some capital in science. He watches science-oriented programmes and his mother had bought him science textbooks. Although his sister aspired to be a doctor/dentist, Kyle seemed to know little about GCSE subject choices regarding science and confessed he has yet to read his science textbooks at home. Kyle and others like him are considered to have a *medium engagement* in science because their involvements and participations in science seem to be in the ‘middle’ in terms of science aspiration, science achievement, science interest and science capital.

Engagement without aspiration refers to students who expressed no aspirations towards science-related careers, despite their tendency to have ‘high’ (but sometimes ‘medium’) levels of achievement and interest in science. Students in this category varied in terms of their science capital, as some, but by no means all, students seemed to possess a range of resources related to science. Students with *engagement without aspiration* in science may perform in science (e.g. through achievement) for reasons other than as preparation for careers in or from science. For example, students may generically aspire towards high academic achievement, which means ‘high’ achievement in science constitutes a part of that overall goal. Recent studies have explored such phenomena through the notions of (gender, class and/or ethnic) performativity (see also Chapter 7) and as something ‘people like me’ do (e.g. Archer and Francis, 2007; Francis *et al.*, 2010; Wong, 2012; see also Chapter 6). There are 10 pupils categorised with *engagement without aspiration* in science: one Pakistani boy, one Bangladesh girl, one Indian boy, and seven Chinese students (4 boys and 3 girls). For instance, Hins (14, M, Chinese, Yangtze) aspires to be in business and rejects the vision of working in science or medical professions in the future (‘it’s not my kind of thing’), despite achieving levels 6 and 7 in science, which may be considered as ‘high’ for Year 9 pupils (DCSF, 2002). Hins finds science to be ‘quite interesting’ and even took up triple award science for GCSE at the time of interview. He appeared to have access to a range of science capital, especially from his father, who has a Master’s degree in physics.

A similar category, *engagement without interest* relates to students who mentioned aspirations towards science-related careers, but who expressed a ‘low’ interest in science. Students in this category tended to have ‘medium’ or ‘high’ levels of science achievement and science capital. There were three girls in this category: one Black Caribbean and two Indian girls. Samantha (13, F, Indian, Cranberry), for example, aspires to study triple award science and to become a doctor, despite her claim of losing interest in school science (‘I’m not really interested in it anymore like now when I listen to science lessons and stuff, I find it really boring and I just don’t really want to listen’). Samantha is in a ‘top set’ for science and is considered a ‘high’ achiever in science (DCSF, 2002). She appears to have a broad spectrum of science capital as members of her immediate and extended family, peer group and science teacher provides her with first-hand knowledge about science and science-related careers (Wong, 2012).

Students with *high engagement* in science had expressed science-related career aspirations and tended to command ‘high’ levels of achievement, interest and capital in science. Similarly, Aschbacher *et al.* (2010) found that high achieving science students with science-related career aspirations tended to have supportive extended family members in science. Students in this category, theoretically, represent those who are most likely to continue the study of science and to enter careers in or from science. There are 10 pupils considered to have *high engagement* in science: one Black Caribbean, one Pakistani, two Chinese and six Indian students (3 boys and 3 girls). Like many Indian students in the study, Denise (11, F, Indian, Cranberry) aspired to be a dentist or doctor and she was seen as a ‘high’ achiever in science, with level 6 grades in Year 7 (DCSF, 2002). She seemed to have a ‘high’ interest in science, claiming the teachers are ‘good’ and ‘teach well’ and the experiments are ‘fun’ and ‘understandable’. Denise also appears to command a ‘high’ level of science capital. For instance, she had a cousin studying dentistry at university and a distant relative who is a qualified doctor. Thus, Denise’s science-related aspirations appeared to be supported by her achievement, interest and capital in science.

This section has described the seven ‘types’ of ‘student science engagement’. The four key components, or ‘markers’, of the ‘student science engagement’ typology: ‘science aspiration’, ‘science achievement’, ‘science interest’ and ‘science capital’,

are now examined separately. In light of the literature which found a diversity in the science participation ‘crisis’ amongst minority ethnic groups (*see* Chapter 1), the influences of gender, class and ethnicity are also discussed within each marker.

Science achievement and the influences of gender, class and ethnicity

‘Science achievement’ refers to the grades achieved by students in their most recent science tests or exams. Using the benchmarks from DCSF (2002) concerning the expected grades for pupils at Key Stage 3 (i.e. Years 7, 8 and 9), three groups of science achievers are identified for each year group: ‘low’, ‘medium’ and ‘high’. Year 7 students in the study with level 4 attainments in science are generally regarded as ‘medium’ achievers. Likewise, Year 8 students with level 5 grades and Year 9 students with level 6 grades may be considered as ‘medium’ achievers. ‘Low’ achievers tended to be the students with grades lower than the ‘medium’ achievers within their respective year groups. Thus, ‘low’ achievers may achieve level 3 in Year 7, level 4 in Year 8, or level 5 in Year 9. Similarly, ‘high’ achievers may attain level 5 in Year 7, level 6 in Year 8, or level 7 in Year 9. As previously mentioned, it is important to acknowledge that the three groups (i.e. as ‘low’, ‘medium’ and ‘high’) of science achievers do not necessarily reflect student ability, but is used only as a category for organising students with different science achievement in school. Although the grades for students’ science achievement are self-reported, their science teachers were consulted (where possible) and information on students ‘ability’ group for science (e.g. ‘top set’, ‘middle set’, ‘bottom set’) were also collected. A subjective judgement was made by the researcher to categorise each student as either a ‘low’, ‘medium’ or ‘high’ science achiever based on the available data.

While students’ achievement in science may differ from their achievements in other subjects, the vast majority of students reported similar grades for science, English and maths (i.e. the core subjects). Some students reported lower grades in science in comparison to other subjects, but no student reported their highest grade to be in science. Of the 46 minority ethnic students in the study, 13 were categorised as ‘low’ achievers, 13 as ‘medium’ achievers and 20 as ‘high’ achievers in science. Students’ science achievements are now examined in terms of gender, class and ethnicity.

Table 4.2: Science achievement by gender, class and ethnicity

	Science achievement group			Total
	'Low'	'Medium'	'High'	
By gender				
Male	8	9	9	26
Female	5	4	11	20
By class				
'Working class'	12	11	15	38
'Middle class'	1	2	5	8
By ethnicity				
Black Caribbean	4	5	0	9
Pakistani	1	2	2	5
Bangladeshi	5	3	1	9
Indian	0	2	8	10
Chinese	3	1	9	13
Total*	13	13	20	46

*Total number of students in each science achievement group

The proportion of boys and girls categorised as 'low', 'medium' and 'high' science achievers are relatively similar, with girls slightly better represented in the 'high' achieving group. As can be seen in Table 4.2, roughly a quarter of boys (n=8) and girls (n=5) were classified as 'low' achievers. Around two fifths of boys (n=9) but only one fifth of girls (n=4) were 'medium' achievers. A similar number of boys (n=9) and girls (n=11) were categorised as 'high' achievers, which represents just under a third of all boys and just over half of all girls in the study. Although the 46 minority ethnic students in the study are not statistically representative, their achievements appear to support TIMMS 2007 survey which reported minimal gender difference in terms of achievements in science for English students in Year 9 (Sturman *et al.*, 2008, *see* Chapter 1). Thus, there seem to be few gender variations in the science achievement of minority ethnic students in the current study.

In line with recent literature (Chang *et al.*, 2007; Gorard and See, 2008, 2009; Royal Society, 2008), minority ethnic students from 'middle class' backgrounds were proportionally more likely than their 'working class' counterparts to be categorised as 'high' science achievers. Although 'middle class' students were represented in each group of science achievers, of the 13 'low' achievers, there was one 'middle class' student and of the 13 'medium' achievers, there were only two 'middle class' students. The majority of 'middle class' students were 'high' achievers (5 out of 8),

as five of the 20 ‘high’ achievers were from ‘middle class’ backgrounds. Less than half of ‘working class’ students were categorised as ‘high’ science achievers (15 out of 38), which appear to support existing statistics that have consistently reported that students from less affluent social backgrounds (e.g. such as those in recipient of FSM) were less likely to achieve in school (e.g. at GCSE benchmark grades) than those from more affluent backgrounds (e.g. non-FSM students, DfE, 2010a).

From Table 4.2, there are noticeable differences between ethnicity and science achievement. On one end of the spectrum, four (out of nine) Black Caribbean students in the study were classified as ‘low’ achiever, five as ‘medium’ achievers, but no ‘high’ achiever. Likewise, of the nine Bangladeshi students, there were five ‘low’ achievers, four ‘medium’ achievers, but only one ‘high’ achiever. Together, Black Caribbean and Bangladeshi students made up almost three quarters of all ‘low’ science achievers (9 out of 13). Pakistani students are evenly spread across the three groups of science achievers. On the other end of the spectrum, Indian and Chinese students dominated the ‘high’ achieving group, representing 17 of the 20 ‘high’ science achievers. Amongst the 10 Indian students, there were eight ‘high’ achievers, two ‘medium’ achievers, but no ‘low’ achiever. Similarly, of the 13 Chinese students, there were nine ‘high’ achievers, one ‘medium’ achiever and three ‘low’ achievers.

The science achievement pattern amongst minority ethnic students in the study seems to reflect national statistics on GCSE attainments (DfE, 2010a, *see* Chapter 1), where Indian and Chinese students tend to achieve ‘above average’ and students from Black Caribbean, Pakistani and Bangladeshi backgrounds tend to attain ‘below average’ at GCSE examinations. These patterns also support the diversity in science participation rates amongst minority ethnic groups (Elias *et al.*, 2006; *see* Chapter 1), since Indian and Chinese students were proportionally overrepresented in the study of science-related degrees (Jones and Elias, 2005). The lack of ‘high’ achievers amongst Black Caribbean and Bangladeshi students support the findings of Elias *et al.* (2006), who found the proportion of students eligible to study undergraduate physics and chemistry to be much lower amongst those from Black Caribbean and Bangladeshi (and Pakistani) backgrounds. Thus, there appears to be a positive link

between high achievement in science and the study of science at higher education (Lau and Roeser, 2002).

An analysis of the influences of gender, class and ethnicity on science achievement (*see* Appendix 12) confirms that amongst minority ethnic students, differences in social class does not necessarily explain all their attainment patterns (Archer and Francis, 2007; Rothon, 2007; Strand, 2011a). For example, although two of the three ‘middle class’ Indian students were ‘high’ achievers, six of the seven ‘working class’ Indian students were also ‘high’ science achievers. However, the small number of ‘middle class’ students in the study (n=8), particularly with only one student from Black Caribbean and Pakistani backgrounds, meant that analysis into the influence of class may be limited. Indeed, there is no ‘middle class’ student from Bangladeshi background. In relation to gender and science achievement, there are no obvious patterns within minority ethnic groups.

This section has examined minority ethnic students’ science achievement by gender, class and ethnicity and found the influences of gender to be minimal in relation to students’ science achievement. However, there were notable differences across class and ethnicity. Consistent with national statistics on achievements (e.g. at GCSE, *see* DfE, 2010a), ‘middle class’ students, as well as Indian and Chinese students, dominated the ‘high’ achieving group. The ‘working class’, and students from Black Caribbean and Bangladeshi backgrounds, generally populated the ‘low’ achieving group in science (Elias *et al.*, 2006). The next section focuses on students’ aspirations towards science, before examining the complex relationship between science achievement and science aspirations.

Science aspiration and the influences of gender, class and ethnicity

‘Science aspiration’, or science-related career aspirations to be precise, broadly refers to students’ ambitions for a career in or from science. Although students may possess more than one career aspiration, including non-science-related careers, they are considered to have a science aspiration if at least one of the careers they aspired is science-related. The purpose of this approach is to separate students with career ambitions that would not normally require any specific scientific knowledge from

students who have career aspirations that may entail the use of science. In the current study, the occupations expressed by students which are considered to be science-related include doctor, dentist, paediatrician, pharmacist, engineer, scientist, architect, pilot, inventor, computer games developer, computer person, energy person and mechanic/electrician. All other professions mentioned, such as lawyer, artist and business, are categorised as non-science-related. On this basis, of the 46 students, 19 were categorised as possessing non-science-related career aspirations and 27 were considered as possessing science-related career aspirations. In DeWitt *et al.*'s (2011b) quantitative survey of 9,319 English students (aged 10-11) views of science, 29% of students agreed that they would like to have a 'job that uses science' in the future. Although white students dominated that dataset, DeWitt *et al.* found students of 'South Asian' heritage (e.g. Bangladeshi, Indian, Pakistani and 'other' South Asian) as more likely to possess science-related career aspirations than white students, which is consistent with minority ethnic students in the current study, where over half (27 out of 46, or 59%) of the students expressed aspirations in science-related careers (*see also* DeWitt *et al.* 2011a). Within those 27 pupils, 16 appeared to have expressed science-related careers as their first/only choice, while the other 11 seemed to have emphasised non-science-related careers as their priority, despite expressing science-related career aspirations (*see* Chapter 5). In this section, students' science aspirations are analysed in relation to gender, class and ethnicity.

Table 4.3: Career aspirations by gender, class and ethnicity

	Career aspirations		Total
	Non-science related	Science-related	
By gender			
Male	10	16	26
Female	9	11	20
By class			
'Working class'	16	22	38
'Middle class'	3	5	8
By ethnicity			
Black Caribbean	5	4	9
Pakistani	2	3	5
Bangladeshi	2	7	9
Indian	1	9	10
Chinese	9	4	13
Total*	19	27	46

**Total number of students with non-science related and science-related career aspirations*

Previous literature on gender and science has mainly focused on the perception of science as a ‘male’ domain (Baker, 1998) and has reported that girls may be dissuaded from science careers as the subject may be seen as inconsistent with their own identities (Schreiner and Sjøberg, 2007; Whitehead, 1996). However, just over half of the girls (11 out of 20) and boys (16 out of 26) in the study expressed aspirations towards science-related careers (*see* Table 4.3) and thus the concerns of science as a ‘male’ domain raised by some previous studies appear less applicable amongst the minority ethnic girls (Mirza, 1992; Archer and Francis, 2007). However, nine of the 11 girls with science aspirations expressed aspirations related to the medical professions (with architecture and archaeology, the two ‘non-medical’ science-related aspirations). Such findings align with the works of Miller *et al.* (2006), who found that science-related aspirations amongst girls tended to revolve around values of ‘helping people’ and being ‘people-centred’, particularly in the medical field (Christidou, 2006; Jones *et al.*, 2000; Masnick *et al.*, 2010). A range of aspirations towards science-related professions were expressed amongst 16 boys, such as in the fields of medicine, engineering and computing.

Unlike Adamuti-Trache and Andres (2008) and Schoon and Parsons (2002), who implied a positive relationship between socioeconomic background and aspirations towards science/professional careers, the influence of social class on students’ science aspirations appeared minimal for minority ethnic students in the study. As can be seen in Table 4.3, the majority of students from ‘working class’ (22 out of 38) and ‘middle class’ (5 out of 8) backgrounds expressed aspirations towards science-related careers (Atherton *et al.*, 2009). Gender differences are also minimal within socioeconomic backgrounds.

In relation to ethnicity, although a high proportion of Bangladeshi (7 out of 9) and Indian (9 out of 10) students in the study expressed science-related career aspirations, a surprisingly low number of Chinese students expressed aspirations towards science-related careers (4 out of 13), given their tendency to be proportionally overrepresented in post-compulsory science education (Elias *et al.*, 2006; Jones and Elias, 2005). While the science aspirations of Indian students are predominately medical-related, no Bangladeshi pupils expressed career aspirations in the medical field. Instead, Bangladeshi pupils expressed science-related career

aspirations in the fields of computing and engineering. A minority of Chinese students in the study expressed science-related career aspirations (i.e. to be an archaeologist, architect, games developer or a vet). Many Chinese pupils, however, aspired to non-science-related careers, such as law, accountancy, business, teaching and sports. The proportion of Black Caribbean and Pakistani students who expressed science-related and non-science-related career aspirations was similar (*see* Table 4.3). It is interesting to note that all seven Bangladeshi and most (3 out of 4) Black Caribbean students with science-related career aspirations are boys, which suggests that aspirations towards science-related careers may be influenced by gender, rather than (or as well as) ethnicity. However, the same cannot be said for Pakistani, Indian and Chinese students as a similar proportion of girls and boys expressed aspirations towards science-related and non-science-related careers (*see* Appendix 13). Indeed, as there are only one Bangladeshi and four Black Caribbean girls (one of whom expressed science career aspirations) in the study, the evidence for meaningful gender differences in the science aspirations expressed by minority ethnic students appears limited.

This section has described and categorised students' aspirations towards science-related and non-science-related careers in relation to gender, class and ethnicity. Although the influences of gender and class appeared minimal in shaping students' aspirations in science, the apparent discrepancies amongst minority ethnic groups and their science aspirations raise interesting questions. For example, why do Bangladeshi and Indian students aspire favourably and Chinese students unfavourably towards science-related careers? The next section attempts to unpack this line of inquiry by examining students' science aspirations alongside their science achievement (Tai *et al.*, 2006), which reflects the first research question of the study (*see* Chapter 3). Chapters 5, 6, 7 and 8 also explore minority ethnic students' science aspirations through the notions of capital, habitus and identity.

The complex relationship between science achievement and science aspiration

In a recent study of 490 12- and 13-year-old students from three deprived schools in the UK, St Clair and Benjamin (2011) found that young people held 'high' educational and occupational aspirations irrespective of gender, social class and

ethnic backgrounds. In the current study, although there were few gender and class differences, there were notable differences amongst students from particular minority ethnic groups in relation to science aspirations, namely the Bangladeshi, Indian and Chinese students. This section explores the first research question of the study (*see* Chapter 3) and investigates the relationship between achievements and aspirations in science.

The findings thus far are that Black Caribbean and Bangladeshi students in the study populated the ‘low’ achieving group, while Indian and Chinese students dominated the ‘high’ achieving group in science. However, as illustrated in Table 4.4 below, students’ career aspirations in science-related and non-science-related careers appeared to operate independently from their science achievement.

Table 4.4: Science achievement type and career aspirations

Science achievement group	Career aspirations		Total
	Non-science-related	Science-related	
‘Low’	5	8	13
‘Medium’	6	7	13
‘High’	8	12	20
Total	19	27	46

In Table 4.4, a similar proportion of minority ethnic students grouped as ‘low’, ‘medium’ and ‘high’ achieving in science can be seen to have expressed aspirations towards science-related careers. Students’ science achievement seems to bear little if any influence on their aspirations towards science-related careers. Such findings may sympathise with the works of Tai *et al.* (2006), who found that lower achieving students with science-related career ambitions were more likely to embark on a science-related degree than high achievers without science-related career aspirations. However, if the assumption that most science-related careers demand a good level of education is warranted, then the chances of students in the current study categorised as ‘low’ achieving succeeding in science-related careers may be lower (than their higher achieving counterparts), given ‘high’ academic achievement is normally required for entry into science-related careers or studies in higher education (Adamuti-Trache and Andres, 2008; Baker and Leary, 1995; Elias *et al.*, 2006).

Indeed, the continued underrepresentation of Black Caribbean, Pakistani and Bangladeshi students studying science in UK higher education (Elias *et al.*, 2006) might also signal the potential challenges facing the seven Bangladeshi boys mentioned earlier in converting their science aspirations into science achievement. Coincidentally, five of those seven Bangladeshi boys with science aspirations are in the ‘low’ achieving group for science (with the remaining two categorised as ‘medium’ achievers). In this case, the five ‘low’ achieving Bangladeshi boys may be in particular danger of ‘leaking’ from the science education pipeline (Elias *et al.*, 2006) as a result of ‘low’ achievement in science rather than a lack of science aspirations. Such an implication could shed light on Mickelson’s (1990) ‘attitude-achievement paradox’, where (science) achievement and (science) aspiration operate on parallel tracks. Previous attempts to explain the ‘gap’ between student aspirations and achievements include their lack of awareness about social inequalities (Mickelson, 1990; Shernoff and Schmidt, 2008), their lack of information about educational and career choices (Kao and Tienda, 1998) and their lack of realistic goals (Schneider, 2009). However, it is important to acknowledge that students’ achievement in science can change over time and that the science grades are mainly self-reported by students in the current study.

This section has demonstrated that students’ science achievement and science aspirations can operate on parallel tracks, which suggests that the ways in which minority ethnic students participate in, or associate with, science are multifaceted. The ‘student science engagement’ typology builds on the analysis of student achievement and aspirations in science and included the ‘markers’ of ‘science interest’ and ‘science capital’, which resulted in a ‘mapping’ of seven ‘types’ of ‘student science engagement’ (*see* earlier). The ‘markers’ of ‘science interest’ and ‘science capital’ are now described.

Science interest and the influences of gender, class and ethnicity

‘Science interest’, or interest in science, refers to the overall view of students toward science, particularly their ‘liking’ and ‘disliking’ of school science. The notion of science interest may be thought of in a similar way as studies that attempt to conceptualise or measure ‘attitudes’ in/toward science (e.g. Cheung, 2009; Kind *et*

al., 2007; Reid, 2006). For example, studies have found that students who ‘enjoy’ science or have more positive views of science tend to achieve higher in science than students who ‘dislike’ science or have more negative science views (Ainley and Ainley, 2011; Papanastasiou and Zembylas, 2002). In other words, previous literature appears to suggest that students’ ‘liking’ (or ‘disliking’) of science could increase (or decrease) their aspirations and/or achievements in science. Thus, students in the current study were asked about their views toward school science in terms of what they liked and disliked. They are later categorised by the researcher as belonging to one of three groups: students with ‘low’, ‘medium’ and ‘high’ interest in science, which draws on student and science teacher interviews and notes from science classroom observations. It should be noted that the classification of students into ‘low’, ‘medium’ and ‘high’ science interest is merely illustrative and highly subjective. The main purpose is to distinguish students who appear to have no interest in science from those who seem enthusiastic and excited about science.

Students categorised with a ‘low’ level of science interest may explicitly express their dislikes of science and/or only have opinions of science as ‘difficult’, ‘irrelevant’, ‘confusing’ and/or ‘boring’ (Lyons, 2004; Masnick *et al.*, 2010). For example, Tim (13, M, Bangladeshi, Everest) said in his interview that he found science ‘a bit boring’. Classroom observations also appeared to suggest that Tim had been losing interest or focus in science, as he was twice noted to be ‘flicking and throwing/spinning his pen into the air while Ms Strauss [science teacher] is talking’ as well as frequently ‘resting his head on his hand’ (Observation notes, Feb. 11th 2010). Interview data from science teachers can also shed light on their experiences of teaching particular students in science. For example, Ms Strauss (34, F, White English, Everest) commented that Tim can ‘sometimes be distracted’ and that he may not be ‘working as hard as he could be’. Students categorised with a ‘high’ level of science interest may have openly voiced and expressed their ‘liking’ of science and/or mentioned their enjoyment of, and interest in, school science. They tended to express few if any negative comments about science. Science classroom observations suggested that these students were engaged and active in class, such as by being responsive in asking and answering questions and appearing focused and interested throughout the lesson. Students classified with ‘medium’ science interest tended to hold both positive and negative views of school science, with neither

outweighing the other. It is interesting to note that the most common ‘dislikes’ about school science expressed by students in the study was the increasing amount of writing/textbook work (Osborne *et al.*, 2003), which was shared by students across all three groups of science interest. Table 4.5 below categorises students’ science interest by gender, class and ethnicity.

Table 4.5: Science interest by gender, class and ethnicity

	Science interest group			Total
	‘Low’	‘Medium’	‘High’	
By gender				
Male	4	10	12	26
Female	6	14	0	20
By class				
‘Working class’	8	22	8	38
‘Middle class’	2	2	4	8
By ethnicity				
Black Caribbean	4	2	3	9
Pakistani	1	4	0	5
Bangladeshi	3	4	2	9
Indian	2	4	4	10
Chinese	0	10	3	13
Total*	10	24	12	46

**Total number of students in each science interest group*

Although there are similar numbers of boys and girls categorised with ‘low’ and ‘medium’ science interest, there is an obvious gender difference in relation to students with ‘high’ interest in science. While almost half of the boys (12 out of 26) in the study have ‘high’ science interest, there are no girls, a finding which appears consistent with a number of studies which found that boys tend to be more interested in science than are girls (Blickenstaff, 2005; Brotman and Moore, 2008; Hill *et al.*, 2010; Weinburgh, 1995).

The majority of ‘working class’ students (22 out of 38) were categorised with a ‘medium’ level of science interest and half of ‘middle class’ students (4 out of 8) were considered to have a ‘high’ interest in science. The ratio of ‘middle class’ students with ‘high’ science interest (in comparison to their ‘working class’ counterparts, which was 8 out of 38) may align with the wider literature on social class and education, which posits that ‘middle class’ students tend to aspire and

develop interest in subjects that considered more ‘prestigious’ and ‘valuable’ (Reay *et al.*, 2001), such as science (Adamuti-Trache and Andres, 2008). Of the 12 boys categorised as having a ‘high’ science interest, four have ‘middle class’ backgrounds, which represents *all* the ‘middle class’ boys in the current study. In this case, students’ science interest appears to be influenced by social class *and* gender.

With the exception of Pakistani and Chinese students, there were no obvious patterns amongst minority ethnic students and their science interest. There were no Pakistani students with ‘high’ levels of science interest and no Chinese students with ‘low’ levels of interest in science, even though the majority of Pakistani (4 out of 5) and Chinese (10 out of 13) students were categorised with ‘medium’ science interest. Thus, the above patterns may have limited meaning. However, when comparing students’ science interest with their science achievement (*see* Table 4.2) and/or aspirations (*see* Table 4.3), a complicated picture emerges (*see* Appendix 14 for cross-tabulations of science interest with science achievement and science aspirations). For example, although the majority of Bangladeshi students aspired to science-related careers (7 out of 9), only two were considered to have a ‘high’ science interest and only one was categorised as being ‘high’ achieving in science. Similarly, while most Chinese students aspired towards non-science-related careers (9 out of 13), no Chinese students are categorised with a ‘low’ interest in science and many (n=9) are considered ‘high’ achievers in science. Indeed, the Chinese students in the study resembled the ‘pragmatic persisters’ as described by Archer *et al.* (2012), in that students continued to perform academically despite a lack of interest due to the intrinsic values embodied through the study of science. Although boys dominated those with ‘high’ science interest, the influence of gender appears minimal across minority ethnic groups.

The notion of science interest was intended to provide an indication of the level of interest students expressed towards school science, which was categorised into three groups for the purpose of illustration: students with ‘low’, ‘medium’ and ‘high’ science interest. Boys, and particularly ‘middle class’ boys, dominated those categorised with a ‘high’ interest in science. Although there appeared to be little difference between minority ethnic groups and their science interest, the marker of

science interest has added an extra layer of understanding into the relationship between students' achievement and aspirations in science and have contributed towards the development of the 'student science engagement' typology.

Science capital and the influences of gender, class and ethnicity

Building on Bourdieu's (1986) notion of capital (*see* Chapter 2), 'science capital' refers to science-related resources available to students, such as experiment kits, museum visits, and knowledge about science from family members, relatives and friends (*see also* Chapter 5). The importance of science capital in students' decision to study post-compulsory science was investigated by Lyons (2006) in the context of Australian students (age 15-16). Lyons found that students who enrolled in 'senior physical science' subjects tended to have family members with science-related cultural and social capital, such as parents with extensive knowledge in, or experiences of, science and science-related careers (*see* Ho, 2010 in the context of Hong Kong students). Similarly, previous studies have also suggested that the lack of science-related capital can contribute towards students' lower aspirations (Adamuti-Trache and Andres, 2008) and achievements in science (Gilleece *et al.*, 2010). Thus, to what extent is science capital positively associated with minority ethnic students' science achievement and/or science aspirations? Students in the current study were encouraged to talk about their participations (or their lack of) in science-related activities in and out of school. For instance, students were asked if they had any science experiment kits at home, if they had visited the science museum and if they had any family or friends who worked or studied in the science field (*see* Appendix 6). Chapter 5 explores the notion of science capital in further detail.

Similar to the three groups of science interest discussed earlier, students were categorised with a 'low', 'medium' or 'high' level of capital in science, where those considered to have had a 'low' science capital appeared to possess little or no capital related to science. For example, Stacey (13, F, Black Caribbean, Barton) admitted that she did not know anyone (e.g. family or friends) with any interests, experiences or aspirations in science or science-related fields. Stacey claimed that she did not participate in any activities related to science as her interest in science was minimal and that she would change channel if a television programme appeared scientific ('I

don't like them'). On the other hand, students categorised with 'high' science capital generally had access to a range of capital related to science. For example, Vincy (14, F, Indian, Cranberry) said she had various science experiment kits and revision textbooks at home and that her parents provided her with private tuition in science and other subjects. Vincy also seemed to have people around her with aspirations, knowledge and experiences in science-related fields, such as her peers and extended family members. A 'medium' level of science capital refers to students with some science-related resources, which tended to be capital that was either cultural or social oriented. For example, Rob (12, M, Black Caribbean, Davidson) claimed to have a science book at home and that he enjoyed watching science-oriented television programmes, such as 'Backyard Science'. However, Rob admitted that people from his social network had no interest, knowledge or experiences related to science. Table 4.6 below illustrates students' science capital as categorised by gender, class and ethnicity.

Table 4.6: Science capital by gender, class and ethnicity

	Science capital group			Total
	'Low'	'Medium'	'High'	
By gender				
Male	7	9	10	26
Female	7	6	7	20
By class				
'Working class'	14	12	12	38
'Middle class'	0	3	5	8
By ethnicity				
Black Caribbean	4	3	2	9
Pakistani	2	2	1	5
Bangladeshi	3	3	3	9
Indian	0	3	7	10
Chinese	5	4	4	13
Total*	14	15	17	46

**Total number of students in each science capital group*

As can be seen in Table 4.6, a similar proportion of boys and girls in the study were categorised in each group (i.e. 'low', 'medium' or 'high') of science capital, which suggests that there were minimal gender differences. Seven boys and seven girls were classified as having 'low' science capital, nine boys and six girls had 'medium' science capital, and 10 boys and seven girls possessed 'high' science capital.

Although students from ‘working class’ backgrounds were evenly distributed across the three groups of science capital (14 with ‘low’, 12 with ‘medium’ and 12 with ‘high’ science capital), just over half of ‘middle class’ students were categorised with ‘high’ science capital (0 with ‘low’, 3 with ‘medium’ and 5 with ‘high’ science capital). Such findings appear consistent with Bourdieu’s theory of class reproduction (*see* Chapter 2), where the possession of legitimate capital is stratified by socioeconomic background, even amongst minority ethnic groups (Ball *et al.*, 2002b). However, such patterns do not appear to take hold in the context of Indian and Chinese students, where the ratio of ‘working class’ students categorised with ‘high’ science capital were greater than their ‘middle class’ counterparts (*see* Appendix 12). For example, seven Indian students were categorised with ‘high’ capital in science: five from ‘working class’ and two from ‘middle class’ backgrounds. In light of this finding, the influence of class on students’ science capital may be limited for some minority ethnic groups (Archer and Francis, 2007, *see* Chapter 5).

In general, a similar number of students were categorised with ‘low’, ‘medium’ and ‘high’ science capital within each minority ethnic group, with the exception of Indian students who tended to possess ‘high’ science capital (7 out of 10). As Indian students also tended to be ‘high’ science achievers (*see* Table 4.2), their pattern supported a positive relationship between science capital and science achievement (Gilleece *et al.*, 2010; *see* Table 4.7). However, not all ‘high’ science achievers (e.g. Chinese students, *see* Table 4.2) possessed a ‘high’ level of science capital. Only four (out of 13) Chinese students were categorised with ‘high’ science capital (*see* Table 4.6), despite the majority (9 out of 13) being classified as a ‘high’ science achiever (*see* Table 4.2). Yet, the low number of Chinese students categorised with ‘high’ science capital may also explain why only four Chinese pupils (*see* Table 4.3) expressed science-related career aspirations (Adamuti-Trache and Andres, 2008). Indeed, there seems to be a pattern (*see* Table 4.8) where students with ‘high’ science capital were more likely to express science-related career aspirations than students categorised with ‘low’ or ‘medium’ science capital.

Table 4.7: Cross-tabulation of science capital and science achievement groups

Science capital group	Science achievement group			Total
	‘Low’	‘Medium’	‘High’	
‘Low’	9	2	3	14
‘Medium’	2	9	4	15
‘High’	2	2	13	17
Total	13	13	20	46

Table 4.8: Cross-tabulation of science capital group and career aspirations

Science capital group	Career aspirations		Total
	Non-science-related	Science-related	
‘Low’	9	5	14
‘Medium’	7	8	15
‘High’	3	14	17
Total	19	27	46

In this section, science capital was conceptualised as resources related to science, which included economic, social and cultural capital (Bourdieu, 1986). In general, science capital appeared positively related to students’ science achievement and aspirations towards science-related careers (*see* Tables 4.7 and 4.8). In line with the existing literature, ‘middle class’ students in the study were generally more likely to possess a ‘high’ level of science capital than their ‘working class’ counterparts, even though such a pattern can be complicated by ethnicity (Archer and Francis, 2007). Although students with ‘high’ science capital tended to have aspirations towards science-related careers, a number of students categorised with ‘low’ and ‘medium’ science capital also expressed aspirations for careers in or from science (*see* Table 4.8). The relationship between science capital and science aspirations is explored further in Chapter 5. A summary of the chapter is presented next.

Summary

This chapter initially set out to investigate the relationship between minority ethnic students’ science achievement and aspirations in science. However, preliminary analysis suggested that further indicators, or ‘markers’, would provide a richer picture into the complex ways in which students can participate and engage in science. A typology of ‘student science engagement’ is proposed through the

‘markers’ of science achievement, science aspiration, science interest and science capital as an attempt to ‘map out’ and capture how minority ethnic students can associate and identify with science. The seven ‘types’ of ‘student science engagement’ were *low engagement*, *wishful engagement*, *ideological engagement*, *medium engagement*, *engagement without aspiration*, *engagement without interest* and *high engagement*. The four ‘markers’ of the ‘student science engagement’ typology were also discussed in relation to gender, class and ethnicity. The ‘student science engagement’ typology will now be used/drawn on in the following two chapters, which explore how and why some minority ethnic students excel, and others do not, in science education, using the theoretical lens of Bourdieu.

Chapter 5 – Bourdieu’s capital, science and career aspirations

Introduction

As discussed in Chapter 2, Bourdieu (1977, 1986) developed the notions of habitus, capital and field to explain social inequalities and class reproduction. This chapter draws primarily on student interview data and explores the usefulness of the concept of capital in understanding minority ethnic students’ science aspirations. In line with Bourdieu, ‘middle class’ students in the study appeared more likely than their ‘working class’ counterparts to possess science capital and aspirations towards science-related careers. However, some minority ethnic students, such as Chinese and Indian students, seemed to have access to capital related to science and education regardless of their socioeconomic backgrounds. In other words, the influence of class on students’ available resources in education may be complicated by ethnicity and cultural discourses, which will be explored in Chapter 6, focusing on Bourdieu’s notion of habitus. Building on the idea of science capital, as introduced in Chapter 4, this chapter investigates the extent to which economic, social and cultural capital can facilitate students’ science and career aspirations. In particular, this chapter proposes the notion of *quality* in relation to social capital, which differentiates the influence of different types of social networks in shaping students’ aspirations towards science-related careers.

Economic capital

According to Bourdieu (1986), the possession of economic capital constitutes ‘the dominant fraction of the dominant class’, as financial dispositions represent the most *exchangeable currency* for the acquisition of other resources such as social and cultural capital. Thus, economic capital is argued to have a high exchange-value, because it can be used to ‘trade’ for material substances, knowledge or experiences (Skeggs, 2004). In the UK, minority ethnic groups tend to be assumed as ‘working class’, and this is evident in many educational research studies which make comparisons between minority ethnic groups and the ‘white working class’, with little or no reference to social class variations within or across minority ethnic groups (e.g. Strand, 2007). While this pattern of research may reflect the view that any

social class advantage by minority ethnic groups can be neutralised by their minority ethnic backgrounds, few studies (e.g. Archer, 2010, 2011) have empirically explored the application of ‘middle class’ in relation to minority ethnic groups. Indeed, Archer (2010, 2011) agrees that the ambiguous notion of social class may not be suitable for minority ethnic groups, since the concept is inherently Western and white. As such, minority ethnic groups in the UK tend to be synonymised with a ‘working class’ background, which, through a Bourdieuan analytic lens, would imply economic capital to be scarce amongst minority ethnic families. Although it is not within the scope of this study to assess the actual financial standing of minority ethnic families, this section exclusively focuses on one aspect – the provision of private tuition – as potentially indicative of the deployment of economic capital amongst minority ethnic groups.

Private tuition can be seen as one of many purchasable resources that can improve students’ academic grades and performances (Bray, 2006), which Smyth (2009) has argued to be a ‘middle class’ phenomenon. In line with Bourdieuan theory, such exchange of economic capital into educational (and cultural) resources (e.g. additional knowledge, learning opportunities) can contribute towards the reproduction of social class inequalities in the field of education (*see* Chapter 2). It is important to note, however, that resources available to students may not always fall (neatly) under the types of capital as conceptualised by Bourdieu (1986). For example, cultural capital related to science education, such as experiment kits, science textbooks or museum visits would arguably also require some economic capital. Despite the potential ambiguity, it is argued here that private tuition is a purchasable resource that is mainly facilitated by economic capital. Ireson (2004) notes various forms of tuition, including ‘individual tutoring’ (one-to-one teaching), ‘small group tuition’ (e.g. after school homework club), additional learning in supplementary schools and parental home teaching. Bray and Kwok (2003: 612) defined private tuition as “tutoring in academic subjects which is provided for financial gain and which is additional to the provisions by mainstream schooling”. Thus, it would seem reasonable to recognise the provision of private tuition as a luxury, purchasable resource, available through the deployment of economic capital.

Eighteen students (out of 46) in the current study explicitly reported receiving private tuition, mostly in mathematics and in the form of one-to-one tuition. A small minority had tuition in the 'core' subjects (i.e. English, mathematics and science) and a handful only had private music lessons (e.g. piano). Although most students (15 out of 18) with private tuition expressed aspirations in a science-related career, only a few ($n=5$) received specific tuition in science. In line with existing literature (e.g. Bray, 2006), the majority of students reporting receiving private tuition (14 out of 18) were categorised as 'high' achievers (in science). There were 20 'high' achievers in the study (*see* Chapter 4), which meant that only six 'high' achieving science students did not claim to have private tuition. Thus, a high proportion of minority ethnic students who claimed to have private tuition (even though most are in maths) tended to express science-related career aspirations and be categorised as 'high' achieving students.

Although there are minimal gender differences (8 boys, 10 girls) between those who reported receiving private tuition, there were notable class and ethnic variations. In line with Bourdieu's theory of class reproduction, minority ethnic students from 'middle class' families (5 out of 8) were proportionally more likely to have private tuition than students from 'working class' backgrounds (13 out of 38). In relation to ethnicity, it is interesting to note that Indian ($n=9$) and Chinese ($n=6$) students dominated those who claimed to receive private tuition (15 out of 18), which may shed light into their tendency to be 'high' science achievers in the current study (*see* Chapter 4) or in national statistics (DfE, 2010a, 2011), even though further research would be required. However, the significance of socioeconomic status in the purchase of private tuition appeared less apparent amongst some minority ethnic groups (Francis and Archer, 2005), as many Indian (6 out of 9) and Chinese (4 out of 6) students who claimed to receive private tuition came from 'working class' backgrounds. While students believed that the main purpose of private tuition was to raise educational achievements, this study has identified three perspectives towards why private tuition was sought after.

The first perspective is perhaps the most obvious: *demands from parents for higher grades*. According to some students, the sole purpose of their private tuition was to improve their academic achievements. For instance, Tim (13, M, Bangladeshi,

Everest) claimed that his parents ‘want me to get [good] grades’ for his impending private tuition in English, mathematics and science. Similarly, Dee (13, M, Chinese, Yangtze) explained that his recent mathematics tuition was the result of concerns raised by his father about his recent mathematics grades (‘it started last week when my dad wasn’t very fond of my scores of getting 70 per cent’). Thus, private tuition was used by some minority ethnic families as a purchasable resource to improve children’s educational performances.

While the provision of private tuition is usually planned and organised by parents (Yamamoto and Brinton, 2010), some students said they actually took the initiative and asked their parents if they could have private tuition. This second perspective can be seen as *demands from students for higher grades*. For example, Ramos (12, M, Indian, Cranberry) explained that his plea for science tuition resulted from his own concerns about his lack of science understanding (‘I really thought I need more help ... I was a bit nervous’). Michael (12, M, Indian, Cranberry) wanted mathematics tuition even though he was ‘getting good grades’ because he was ‘stuck on some of these questions’ and that he aspired ‘to do well in GCSE maths’. Students’ apparent insistence to learn (or achieve) more/higher may reflect an ‘achievement oriented’ habitus (*see* Chapter 6) in which they reside, of what ‘people like me’ *should* be doing, achieving or aspiring.

The third perspective was shared by Indian and Chinese students, of a *culture of private tuition*, where private tuition appears embedded within their everyday life educational experience (i.e. habitus). For instance, Gigi (11, F, Chinese, Yangtze) implied that her regular attendance at an evening, private tuition school, was customary and routine (‘I go to *Hanson* [private tuition school]... it’s kinda the same, where, erm, you either go there on Mondays or Wednesdays, to pick up like work to do every day’) while Becky (13, F, Indian, Cranberry) recalled how she has had private tuition since Year 2 (age 7-8), with her dad ‘happy to pay’ as long as she was interested.

Although minority ethnic students who received private tuition tended to be ‘high’ science achievers (Bray, 2006), the deployment of economic capital (e.g. the purchase of private tuition) amongst minority ethnic families did not necessarily

follow Bourdieu's theory of class reproduction. While Smyth (2009) argued that private tuition tends to be the privilege of 'middle class' families, many Indian and Chinese students from 'working class' backgrounds also claimed to have access to private tuition (Archer and Francis, 2007). Thus, ethnicity may have complicated the view that the 'working class' does/can not invest economic capital into their children's education. Indeed, Archer and Francis (2007) found that British Chinese families in their study invested economic resources in the education of their children even when available finances were low, because educational success was seen to be the main vehicle for upward social mobility. According to the authors, such perceptions may reflect a family discourse of 'valuing education' within the British Chinese family habitus – an issue to be explored in the next chapter.

Social capital

This section explores the ways in which minority ethnic students' science and career aspirations can be inspired, influenced or encouraged by/within their social networks. For Bourdieu, social capital is:

The sum of resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalised relations of mutual acquaintance and recognition (Bourdieu and Wacquant, 1992: 119).

Bourdieu viewed the resources one is able to draw upon from their social memberships and networks as reflective of their social class position, which informs the reproduction of social inequalities (*see* Chapter 2). Previous studies (e.g. Huang, 2009; Martin, 2009) have consistently found that students with wide-ranging social networks tend to command 'higher' career aspirations and educational achievements. Although it would be difficult to confidently establish whether students' ambitions are initially inspired or later supported by their social network, this section examines the influences of family members, peers and the local community (Robb *et al.*, 2007; Royal Society, 2004; Wang and Staver, 2001) in shaping minority ethnic students' views of, and aspirations towards, science. It is suggested that Bourdieu's concept of social capital may be further refined by the notion of *quality*. The idea of *higher*

quality and *lower quality* social capital is proposed as a means to distinguish various forms of social capital available to students.

Twenty-seven students were identified in Chapter 4 with science-related career aspirations and the majority of these students seemed to command some form of science-related social capital, particularly from siblings, relatives and extended family members. For example, Denise (11, F, Indian, Cranberry) aspired to be a doctor or dentist and she appeared to have ‘science social capital’ from her sister, cousin and a distant relative, whom Denise said was a high science achiever in school, a dentistry student at university and a qualified doctor. Similarly, Ronnie acknowledged the influence of his cousin for his aspiration to be an engineer:

One of my older cousins, I think he’s like 20 or something, he does like building and I use to like sometimes, he use to call me and ‘I got a job, you wanna come and see and help me?’ and I’m like ‘yeah yeah’ and ... when I do and see him doing it and I help him out I like that, the way like he thinks, like, how to fix, how it all work out. (Ronnie, 14, M, Bangladeshi, Everest)

Ronnie’s ‘engineering social capital’, through his cousin, seems to have enabled him to gain practical experiences, exposures and external knowledge related to the field of engineering outside of his usual school and home learning environment. Siblings were also mentioned by students as a source of educational knowledge and advice (Cox, 2010; Crozier and Davies, 2006; Morrow, 1999). For example, Becky (13, F, Indian, Cranberry) said she was warned by her older brother of the need to be mathematically competent to study triple science (at GCSE) and Norman recollected the advice offered by his brother in education:

He sometimes like shouts at me saying ‘you should do that, why don’t you do work on that’, he’s like saying how he didn’t do well and wants me to do well. (Norman, 12, M, Pakistani, Barton)

According to Song (1999), who investigated British Chinese children’s participation in family-based businesses, the influence of siblings can supersede that of parents on issues such as education or career choice, because British Chinese parents often

lacked English language competences and/or broader knowledge of career opportunities in mainstream British society (*see also* Archer and Francis, 2007). Likewise, Crozier and Davies (2006) echoed the importance of siblings and extended family members (e.g. cousins) for educational knowledge, advice and inspiration amongst British Bangladeshi and Pakistani students. For some minority ethnic students then, siblings and extended family members can be influential for career inspirations as well as being perceived as ‘legitimate’ advisors for educational (and career) choices.

Although some studies have noted peers to be influential in shaping students’ aspirations towards science-related careers (e.g. Rodrigues and Jindal-Snape, 2010), there was only one instance across the student interview transcripts where peers were cited as the source of inspiration in students’ own development of science aspirations. Vincy, a 14-year old Indian girl, appeared to be the only student in the study who has credited her friends for propelling her interest in a science-related career:

Yeah, like pharmacy, it wasn’t mine, I didn’t want to do it at first, but cos my friend did it, erm, like after knowing more detail and stuff, I thought it would be more interesting than a bank manager. (Vincy, 14, F, Indian, Cranberry)

In this case, Vincy’s peers may have helped her to broaden her insights and career aspirations in a science-related field (Brooks, 2003). However, Vincy’s deepening interest to be a pharmacist were also supported by other forms of social and cultural capital in that she has cousins who are studying pharmacy and a qualified pharmacist who is a family friend. The story of Vincy was rare. There were more examples of students who appeared to distance their own career aspirations from that of their peers. For example, Tim (13, M, Bangladeshi, Everest) aspired to be in business and said he could not relate to the ambitions of most his friends, who wanted to be ‘lawyers’ and ‘car designers’ (‘I don’t really care what they think cos most of them what they say is stupid’). Similarly, JJ (12, M, Black Caribbean, Barton) was keen to flag up that he has ‘high’ ambitions in contrast to some of his ‘low’ aspiring peers (‘some just want to be cashiers ... nothing that I would pick’). However, the data collected were insufficient for analysis into the social backgrounds (e.g. such as

gender, class and ethnicity) of students' peer groups, and how particular peers may shape students' aspirations. Further study is merited. Although Strand (2007) found that young people's educational aspirations tended to reflect their peer groups, the same cannot be said for students' career aspirations as the influence of peers on students' career aspirations appear minimal.

In addition to extended family members and peers, social capital within the local community can also facilitate particular career ambitions (Coleman, 1988, 1990; Zhou, 2005, 2009), notably amongst some Indian students in the current study who were recruited from an area with a high Indian population. Vincy, who aspired to be a pharmacist, revealed the profession of doctor as the *expected* ambition and career pathways of Indian children in her local Indian community:

Like, all [Indian] parents say 'oh you're gonna become a doctor when you grow up' and I don't know why but all of them say this, even like my parent said that, everyone's parent say it. It's like a doctor is a common job. (Vincy, 14, F, Indian, Cranberry)

Indeed, the proliferation of medical-related careers within her local ethnic community may have also shaped Vincy's own career aspirations to be a pharmacist (in addition to her peer influences, *see* earlier). As Vincy recalled:

I wanted to become a pharmacist because there's a pharmacy like near us, and like watching them what they do and stuff I find it interesting, because they learn more about medicine and like what can cure you and stuff, so I wanted to go into that. (Vincy, 14, F, Indian, Cranberry)

Similar experiences were shared by Becky, a close friend of Vincy, who also aspired to be a pharmacist. She seemed to derive science social capital from knowledge that someone within her local community was a pharmacist, even though there was no direct communication:

My aunty is a pharmacist and I just got interested and I like learning about medicine and stuff ... she's not like my real aunty ... I don't talk to her I just know she's a pharmacist. (Becky, 13, F, Indian, Cranberry)

In other words, Vincy and Becky's aspirations to be a pharmacist appear to be facilitated, supported and probably encouraged within their local community. As such, resources within an ethnic community can propel particular expectations, aspirations and career routes for its members (*see* Zhou, 2009 on Korean and Chinese communities in the US). However, it is interesting to note that such form of 'community social capital' (Coleman, 1988, 1990) which appeared to facilitate specific (e.g. medical) career aspirations were not apparent amongst students from the other minority ethnic groups in the study even though particular family resources (*see* 'Cultural capital') can also inform students' career aspirations (Archer and Francis, 2006).

As Bourdieu (1986) considered social ties and connections to be social capital when one is able to mobilise them effectively, analyses of student interview data have unravelled a discourse of *under-utilised (social) capital*, where resources available to students appeared to be recognised but not realised. For instance, Mani (13, F, Pakistani, Barton) aspired to be a doctor and she seemed to have social capital in her aunty who prescribed drugs at *Boots* (a national pharmaceutical chain with health and beauty products). However, Mani sought advice and suggestions on cosmetics rather than medical-related knowledge from her aunty ('I ask her a lot of questions about makeup cos she works at Boots!'). Similar findings were reported by Brickhouse and Potter (2001) through the case of 'Crystal', an African American schoolgirl who was not recommended by her teacher to study an advanced computing course. According to Brickhouse and Potter, Crystal failed to maximise her available capital when she sought help from her mother, who had limited knowledge about computers, over her stepfather, who worked in the computer industry. In this case, social capital related to students' own career aspirations does not necessarily mean that such resources are utilised in beneficiary ways, because the *process* of knowledge, experience or material transfers must also be considered (Coleman, 1988, 1990).

Unlike Bourdieu (1986), who appears to have taken the ‘conversion’ of capital for granted in his theory of social class reproduction, Coleman’s (1988) theory of social capital focused on the processes of resource transmission within the family and community. For Coleman (1988), available resources would have little value if it cannot be accessed or utilised. Thus, Coleman’s theorisations of social capital may be of some value in understanding how capital may (or not) be optimised. Similarly, Anthias (2007) suggests in her discussion of ethnic ties that resources from/through social networks are only social capital when they can be mobilised, in a similar vein to Skegg’s (2004) application of ‘use-value’ and ‘exchange-value’ in relation to capital.

So far, some forms of social capital (e.g. extended family members) appeared to be more significant than others (e.g. peers) in shaping minority ethnic students’ science and career aspirations. The subsection below takes this apparent discrepancy further and proposes the notion of *quality* within social capital.

The notion of ‘higher quality’ and ‘lower quality’ social capital

As mentioned in Chapter 4, of the 27 students who expressed science-related career aspirations, 16 appeared to have prioritised their aspirations in a science-related profession (i.e. as ‘first choice’) while the remaining 11 seemed to have a non-science-related career as their ‘first choice’ (and science-related careers as ‘second choice’). It is interesting to note that nearly all (except one) students with science-related careers as their ‘first choice’ either knew someone in or who had aspirations towards a science-related field (i.e. they had science social capital). In contrast, only five (of the 11) students with science-related career aspirations as a ‘second choice’ appeared to have social capital in science. Although science social capital appeared positively related to students’ aspirations towards science-related careers (*see earlier; Aschbacher et al., 2010*), this subsection argues that social capital in science can be distinguished by type, or *quality*. The concepts of *higher quality* and *lower quality* social capital are proposed as a potential theory for understanding students’ priorities in relation to their science-related and non-science-related career aspirations. The examples of Eric and Samantha are first presented to illustrate how the concept of social capital may be refined by *quality*.

Eric (14, M, Bangladeshi, Everest) has ambitions to be a restaurateur ('first choice') or an 'energy worker' ('second choice'), with the latter inspired by a talk in school by professionals from a national gas and electricity company. Such 'external' input (and capital) had provided Eric with knowledge about the energy sector and his social capital in this field was further reinforced by his peers, who Eric notes were excited by the prospects of a career with this energy company. However, Eric prioritised being a restaurateur and he appeared to draw inspiration from the 'success' of his friend's father, who owned a restaurant. For Eric, his social capital in the field of catering was also strengthened through his regular contact with his friend's father who owned a restaurant. In this case, although Eric had social capital in the energy sector as well as the catering industry, Eric's personal knowing of someone *in* the food business is argued to be of *higher quality* than his social capital through his peers, who only *aspired to* work in the energy sector (which is argued to be a *lower quality* social capital). Thus, Eric's preference to be a restaurateur may have been consolidated through his personal knowing (and knowledge) of someone *in* the catering industry, whom he personally knew and was able to converse with regularly. Indeed, Eric's interest in the energy sector may also decline in due time since existing studies have raised concerns over the long-term influences of 'one-off' career talks in shaping students' career or science aspirations (Royal Society, 2004), especially since Eric's capital in the energy sector appeared limited to his peers who only shared similar ambitions (and thus a *lower quality* social capital).

Samantha (13, F, Indian, Cranberry) had aspirations to become a doctor or a lawyer, but she appeared to have been swayed towards a career in law because she had 'law social capital' in her uncle and aunt, who were practising lawyers. For Samantha, the potential support available from her extended family members was attractive, even though she also had social capital in the medical field, notably from her peers who shared similar aspirations. As Samantha explained:

If I did want to be a lawyer my uncle and aunty can help me a lot because they are either lawyers or solicitors I'm not sure, and so, they can help me a lot and guide me. (Samantha, 13, F, Indian, Cranberry)

Thus, the assumption of specialised support from members of her extended family is likely to have persuaded Samantha towards a career aspiration related to law. For Samantha, her personal knowledge of someone *in* a particular field (i.e. law, which represents a *higher quality* social capital) appeared more valuable and relatable than her knowledge of someone aspiring *to* a particular field (i.e. medicine, which represents a *lower quality* social capital). Indeed, for Samantha, a career in law may not constitute only a ‘known’ but also a ‘safe’ career route because her uncle and aunt are already working as ‘lawyers or solicitors’.

According to Archer and Francis (2007), ‘known’ and ‘safe’ routes are encouraged by minority ethnic families as strategies to ensure success and avoid downward mobility, because the family:

...possess relevant social and cultural capital with which to facilitate their children’s entry and progression into these professions and/or that the family are able to draw on the experiences of relatives from within their wider familial and community networks and/or older siblings who had managed to access professional careers (Archer and Francis, 2007: 135).

While ‘safe’ routes are obviously also ‘known’ routes, the former can also represent a form of ‘risk management’ (Archer and Francis, 2007) where particular careers are encouraged/aspired on the basis of proven success by people whom the family personally knows. Thus, particular careers may be seen as (im)possible and (un)achievable, demonstrated by the previous experiences or (lack of) success of people whom the students know personally. In this sense, *higher quality* social capital, such as personal knowledge of someone *in* the field, can be seen as a prerequisite for ‘safe’ routes.

For Eric and Samantha, their ‘first choice’ career aspirations (which were non-science-related) appeared to reflect personally knowing someone *in* that particular field. As different forms of social capital appear to have a different (exchange-)value (Skeggs, 2004) in shaping students’ career aspirations, the notion of *quality* can be a useful lens for understanding the influences of various social networks. While the notions of use-value and exchange-value distinguish the value of different capital

within and across particular social boundaries, such as peer groups, minority ethnic communities and/or wider society, the notion of *quality* in relation to social capital focuses on the value of particular types of social networks. *Higher quality* social capital is argued to be the personal knowing of someone *in* a particular career field, while the knowledge of someone with similar ambitions is argued to be a form of *lower quality* social capital. Indeed, *higher quality* social capital can, in theory, only have use-value (e.g. valuable only within a particular community, but not wider society) within Skegg's (2004) conceptualisation, even though the data suggest that minority ethnic students tended to prioritise their aspirations towards careers in which they have *higher quality* social capital.

Although Bourdieu's (1977, 1984) notion of social capital does not distinguish the values of specific social networks, his capital theory supports his broader work on social class reproduction (*see* Chapter 2). It is perhaps unsurprising that 'middle class' students in the current study were proportionally more likely than their 'working class' counterparts to possess *higher quality* social capital related to science, irrespective of their own career aspirations. As mentioned in Chapter 4, five (out of 8) 'middle class' students and 22 (out of 38) 'working class' students expressed career aspirations in a science-related field. However, seven (out of 8) 'middle class' and 13 (out of 38) 'working class' students claimed to personally know someone working or studying (at post-compulsory level) in a science-related field. Thus, there were more 'middle class' students with *higher quality* science social capital (n=7) than those with science-related career aspirations (n=5), while just half of 'working class' students with science-related career aspirations had *higher quality* science social capital. In line with Bourdieu's social class theory, 'middle class' students would tend to command a portfolio of 'valuable' capital, such as *higher quality* science social capital, to ensure maximum chances of 'success' (in education or career), even if these students (e.g. Amy, Tracey and Hins) aspired to non-science-related professions (Bourdieu, 1986).

Although many students in the study (across gender and ethnicity) tended to know someone *in* the field of their career aspirations, particularly from members of the extended family or community, it is notable that the majority of Bangladeshi students with science-related career aspirations (6 out of 7) lacked such forms of

higher quality social capital (e.g. Jube, Tim, Saijef, Amir, Ralph and Eric). Their science social capital seemed to be restricted to their friends, who, at most, shared the same science-related career aspirations. In other words, most Bangladeshi students with science-related career aspirations appeared to possess only *lower quality* science social capital, which could also provide some explanation for the dominance of Bangladeshi students categorised with *wishful*, *ideological* and *medium engagement* in science (see Chapter 4 and Appendix 11).

The *quality* of social capital possessed by students can potentially shed light into the ‘aspiration-achievement paradox’ (DeWitt *et al.*, 2011a; Mickelson, 1990). On the one hand, the awareness of someone aspiring *to* a particular field may extend the range of possible careers that are ‘thinkable’ (i.e. *habitus*) for students to consider or aspire to. On the other hand, these ambitions could remain ideological or unrealistic if students are unable to realise and/or meet the requirements necessary to progress or achieve those aspirations. Thus, *lower quality* science social capital may have partially contributed towards an ‘aspiration-achievement paradox’ and provide some explanation about students who were categorised with *wishful* and *ideological engagement* with science (see Chapter 4).

As discussed in this section, knowing someone appears to be significant in students’ ‘first choice’ career aspirations, with extended family members the most common source of inspiration, encouragement and knowledge. Such forms of social capital can provide students with a ‘known’ and ‘safe’ route, where particular career pathways are seen as possible and achievable, demonstrated by the previous experiences or successes of people whom the students know. It is important to recognise, however, that science social capital can be a pull as well as a push factor, as students may reject a science-related career precisely because of the knowledge or advice from members of their social network who may be *in* or have aspirations *to* a science-related profession. In *Distinction*, Bourdieu (1984) operationalised a range of cultural activities and knowledge as markers of ‘middle class’ and ‘working class’ cultural capital. The same principle may be applied to social capital. The role of social capital – that is, resources from one’s social network – in shaping students’ science and career aspirations is proposed in this section to be distinguishable by *quality*, such that knowing someone *in* a particular career is of *higher quality* than

knowledge of someone aspiring *to* that particular profession. In line with Bourdieu's social class reproduction theory, a classed difference also emerged as 'middle class' students were proportionally more likely to have access to *higher quality* science social capital than their 'working class' counterparts, which appear to support high achievements in science (*see* Table 4.2 and Chapter 4). The next section examines the role of cultural capital in moulding students' science and career aspirations.

Cultural capital

Cultural capital was conceptualised by Bourdieu (1977, 1984, 1986) as the legitimate forms of knowledge and non-financial resources that can yield various advantages within a society. Like economic and social capital, Bourdieu conceived holders of cultural capital to vary by social class position, with 'middle class' families privileged over the 'working class'. According to Bourdieu and Passeron (1990), the 'middle classes' possession of cultural capital means that they tend to perform better in education because the educational system reflects 'middle class' values. As mentioned in Chapter 2, Bourdieu's cultural capital can exist in three forms: embodied, objectified and institutionalised. Previous studies tend to operationalise the concept of (educational) cultural capital in quantifiable terms (i.e. objectified cultural capital), such as through frequencies of museum visits, attendance to concerts and participations in extra-curricular activities outside school, such as music, art or dance classes (De Graaf *et al.*, 2000; Dumais, 2002). This section explores students' cultural capital related to science, focusing on science-related extracurricular activities (as an example of objectified cultural capital) and the role of parents, such as their expectations for their children and their backgrounds in science (as an example of embodied and institutionalised cultural capital).

Consistent with recent literature (DeWitt *et al.*, 2011b; Archer *et al.*, 2012), the majority of students in this study – with or without science-related career aspirations – appeared to have participated in a range of out-of-school activities related to science, such as experiment kits, science equipments, science books and textbooks, science tuition, school science club, visits to science and natural museums, watching science-related television programmes and documentaries, and the use of the internet for science learning. For example, JJ (12, M, Black Caribbean, Barton) had

aspirations to be an inventor, and he could be seen to have science cultural capital because at home, JJ had a telescope and a human body apparatus ('I got a human body thing like you can take out the intestine and put it, just like, different pieces you can put together inside the body'), and his scientific interest and knowledge appeared to be enhanced by his regular viewing of science-oriented programmes such as 'Brainiac' and 'Bang Goes the Theory':

JJ: ... it was on yesterday, this guy got a big jar of, what's it called liquid oxygen? You know that really really cold stuff...nitro?

INT: Nitrogen, I think...

JJ: And like, he was thinking of a way to freeze peas, and like, the freezer will take you long and like, he put some in a jar with lots and lots of ice-cube and yeah, and put the peas inside it, was like frozen peas in like 5 seconds, I recorded it!

JJ also confers with internet resources ('I got erm, [BBC] Key Stage Bitesize, which is like a website for maths, English and science, and it's erm, this game, called, science quiz, and I play that a lot'), which could increase or improve his science competence or interest, in and out of the school domain (Bright *et al.*, 2005). For most students, their range of science-related extra-curricular activities appeared less extensive than in the case of JJ. For instance, Rob (12, M, Black Caribbean, Davidson), who also aspired to be an inventor (as well as a footballer), only had a science book about the Earth. He enjoyed watching 'Backyard Science', a programme where 'people [do] experiments in their gardens ... and you can do it at home as well'. However, his practical experience with science (outside of school) seemed limited, as Rob rued his lack of 'resources' to try science experiments at home. In this case, Rob's interest in practical scientific experiments may have been limited to the school.

Across student interview transcripts, science-oriented television seemed to be the most popular source of science-related knowledge outside school, which is unsurprising given the high accessibility of this medium. For some students, knowledge from television programmes appeared to have propelled their science ambitions, as in the case of Shane, who wanted to cure people by being a scientist:

Watching stuff on the TV, like the news, watching people like with breast cancer, liver cancer and all that rubbish and no one really...scientists aren't doing enough to help them...cos Jade Goody, she died of cancer. (Shane, 11, M, Black Caribbean, Barton)

Indeed, the media can also be the source of inspiration for students' career aspirations. For example, Gina's (11, F, Black Caribbean, Barton) aspiration to be a policewoman appeared to be stimulated by the television programmes that she watched ('my mum put this TV programme, it's like a police programme, they like, investigate stuff and like that, and then that's when I started to like it'). Similar findings were also reported by Parker (1995) in his study of British Chinese teenagers, where Chinese television dramas were noted as an influential source of career inspirations. However, although the media may propagate career ideas, such inspirations may be temporary, as in case of Joanna (14, F, Chinese, Yangtze), who recalled her aspirations to be a forensic scientist after watching a television drama about that profession. However, her aspirations to be a forensic scientist were short-lived as she lost interest soon after the television drama ended. Joanna imagined herself be a piano teacher in the future, as she had been playing music since Year 3 (age 7-8), which suggests that the influence of the media may be limited to as a source of inspiration. For such inspiration to develop into an aspiration (or 'longer-term' ambition), other forms of social and/or cultural capital may be needed. Although students with 'high' science capital tended to be 'high' science achievers (see Table 4.7), no obvious patterns were found between student participation in science-related activities and their aspirations towards science-related careers (*see* Chapter 4). The role of the family is now explored in relation to minority ethnic students' science aspirations.

Across the dataset, 13 students were identified as having parents who seemed to possess some form of science-related expertise (e.g. they had 'science-knowledgeable' parents), through occupation, education or personal interest (e.g. the parent worked as an engineer, a doctor, a pharmacist, in computer-related business, in technician/mechanic-related roles; possessed a university degree in the science field; were referred to as 'science nerd'). Although Gilmartin *et al.* (2006) found that

having a family member with a science-related job does not influence students' career interests in or from science, nine (out of 13) students with 'science-knowledgeable' parents expressed science-related career aspirations. As there are 27 students who expressed aspirations towards science-related careers (*see* Chapter 4), this meant that there were 18 (out of 33) students with science-related career aspirations but without 'science-knowledgeable' parents. While students with 'science-knowledgeable' parents (9 out of 13) were slightly more likely to have aspirations towards science-related careers than students without 'science-knowledgeable' parents (18 out of 33), most students with 'science-knowledgeable' parents were also 'high' science achievers (9 out of 13) (*see* Chapter 4), which suggests that 'science-knowledgeable' parents had a positive influence on students' science achievement and aspirations.

Indeed, parents can also exert particular aspirations on minority ethnic students (*see* Chapter 1). In relation to career routes, the most popular careers aspired to by parents for their children (according to minority ethnic students in this study) were in a medical-related profession, followed by careers in finance (including accountancy, banking) and law, which are all 'professional' careers (e.g. Class 1 on NS-SEC, *see* Strand 2007). While Indian and Pakistani students mentioned that their parents tended to have aspirations for them to work in the medical field (Asher, 2002; Springate *et al.*, 2008), particularly as a doctor, many Black Caribbean students said their parents had no (or they are unaware of any) preferences for their career ambitions, with 'my parents [...] wants me to be happy' (Rob) and 'they support me on whatever I want to do' (Stephen) being typical responses (*see* Chapter 6 on the educational discourse of 'doing your best'). However, the ratio of Black Caribbean students with and without science-related career aspirations was comparable to pupils from other minority ethnic groups (*see* Table 4.3 in Chapter 4).

According to many Bangladeshi and Chinese students, their parents wanted them to have 'professional' jobs (e.g. as a doctor, lawyer, banker or accountant). For example, Amir (14, M, Bangladeshi, Everest) had ambitions to work in a bank because his father had promoted it as 'a good job and not too hard', even though Amir was aware that neither his father (nor any family members) knew anyone or had any knowledge of the banking sector. Amir's father was a computer technician

and his mother was a housewife. Nevertheless, Amir aspired to be a bank manager, claiming ‘it’s not really a hard job and if you’re smart, you’ll find it easy’. In this case, parental aspirations for children in ‘professional’ careers may be read as a form of cultural capital, as parents could widen the scope of ‘thinkable’ careers amongst minority ethnic students, even though parents themselves may have limited experiences, knowledge or resources related to those fields (Archer and Francis, 2006). Unsurprisingly, the majority of students claimed that their career aspirations were supported, encouraged and even desired by their parents (i.e. students believed that their aspirations matched those of their parents). However, the potential drawback is that the careers aspired or suggested by parents may have contributed towards the ‘aspiration-achievement paradox’ and resulted in students having unrealistic goals (e.g. students with *wishful* and *ideological engagement* in science, see Chapter 4).

It is interesting to note that some students (mainly from Indian and Chinese backgrounds) said that there were particular subjects that their parents would like them to study or excel in, namely their heritage language and mathematics. In a focus group discussion, Vincy revealed how she would ‘*have to do Punjabi for GCSEs*’ and she later implied (in her individual interview) that knowledge of Punjabi would enrich her ethnic, cultural and religious identity (Francis *et al.*, 2009; Jaspal and Coyle, 2010; Lee, 2002):

Erm, because it’s like my home subject, like my home religion and stuff, so my mum said it’s better if you get a GCSE in it, cos even my brother got it, and my whole family has got it as well, so, I want to do more and learn more about my religion and language and stuff. (Vincy, 14, F, Indian, Cranberry)

Similarly, Matt appreciated the time and effort his mother had invested helping and preparing him for his GCSE Chinese examination:

My mum’s like really hard working, trying to get my sheets printed and the tapes recorded on ... she’s trying to help me really, and my mum’s trying to help me with the writing and the words. (Matt, 13, M, Chinese, Lancang)

Unlike Vincy, who appeared to be learning Punjabi for the purpose of cultural identification, Matt seemed to approach the study of Mandarin as an additional skill-set, as he claimed that fluency in Mandarin ‘could get me a job’ in the future (e.g. in China). Similarly, the desire of some parents for their children to study mathematics followed a similar philosophy, where competence in mathematics was considered by parents to be beneficial for the future, such that it had a high ‘exchange-value’ (Skeggs, 2004). As Gigi (11, F, Chinese, Yangtze) noted, ‘my mum wants me to be better at maths ... because it’s really important’. Likewise, Dee (13, M, Chinese, Yangtze) stressed that his parents ‘push me on maths ... I don’t know [why], I think, you have to learn these ones, and other ones you don’t really need it in daily life’. As can be seen, some parents appeared to have prepared their children with knowledge on subjects they saw as beneficial and valuable in the future (e.g. mathematics). Although such forms of educational cultural capital may typically be associated with the ‘middle class’ (Bourdieu and Passeron, 1990), in this study, it was mainly students from Chinese and Indian backgrounds, irrespective of class backgrounds, who cited parental aspirations for particular subjects. In this case, cultural capital from parents may be bolstered by cultural discourses (Archer and Francis, 2007).

A minority of students also mentioned that they attended weekend complementary schools, such as for religious purposes (‘on Saturdays and Sundays I go to a class, for religion, for two hours ... I’m practising to be a Muslim’, Norman), for academic purposes (‘I use to go to like Saturday schools ... it’s like only, like my race, people, you know ... and we use to sit like for 3-4 hours and we use to do like maths, English and science’, Ronnie) and for heritage language education (a methodological bias meant nine out of 13 Chinese students in the study were recruited from Chinese complementary schools, where students were taught Mandarin and/or Cantonese, *see* Chapter 3). For Ronnie however, complementary education was viewed as ‘having fun’, and thus the value of his participation for academic progress or learning is debatable, as he himself admits:

But like, I think it was a waste of time cos I was like with my cousin and with my cousin there I’ll never concentrate, we just like throwing papers at them, it was so fun, I went there for fun. (Ronnie, 14, M, Bangladeshi, Everest)

As mentioned earlier (*see* ‘Social capital’ earlier), available resources may not always have been utilised as they could be ignored, resisted and even played down. For Bourdieu (1986), individuals appear to be conceptualised as rational beings, such that people will *always* utilise their available (e.g. economic, social and cultural) capital in a self-beneficiary, and often uniform way. In other words, Bourdieu appeared to take for granted that the (re)production of educational inequality is permitted by those who possess various forms of (cultural) capital, without the consideration that available capital can be *under-utilised*. Indeed, there are some occasions where students (mainly Bangladeshi) appeared to reject science-related cultural capital, constituting a discourse of *under-utilised (cultural) capital* in relation to science. For example, Kyle (14, M, Bangladeshi, Everest) was provided with science and mathematics textbooks by his mother, but he admitted that he had not ‘looked at it yet’, which demonstrated that while such science-related resources may be available; it cannot be assumed to be (fully or sufficiently) utilised. In other words, Kyle is unlikely to have reaped any significant benefits from this form of science cultural capital (i.e. science textbooks). Similarly, Fay (13, F, Bangladeshi, Barton) noted her parents’ enthusiasm towards science and mathematics, with her mother particularly keen for Fay ‘to be good at maths’. However, Fay appeared to reject the advice of her mother by responding ‘you need English because, obviously, we’re in England’. Fay also recalled how her mother tried to ‘force’ her to join the school science club while her father ‘tried to make’ her watch the Discovery Channel. Although science-related cultural capital was available to Fay in the form of parental advice and involvement in her science education, she seemed to actively resist this form of science cultural capital. Fay’s apparent refusal of her available science capital is suggested to be in conflict with her identity and aspirations to perform hetero-femininity and be ‘famous’, which is discussed in Chapter 7 (*see also* Wong, 2012).

This section has discussed the influence of science cultural capital on students’ science and career aspirations. Most students in the study, regardless of their aspirations, were found to have had experiences of science-related extra-curricular activities. Although students with ‘science-knowledgeable’ parents were more likely to excel in science (e.g. categorised as ‘high’ science achiever), the influence of parents appeared limited in shaping students’ aspirations for science-related careers.

However, parental aspirations for children to excel in particular subjects, such as mathematics, may shed light into the dominance of Indian and Chinese students who were categorised as ‘high’ science achievers (*see* Chapter 4).

Summary

This chapter has tested Bourdieu’s notion of economic, social and cultural capital in relation to minority ethnic students’ science and career aspirations and found that his theory of social class reproduction was not always evident as some ‘working class’ minority ethnic students seem to possess ‘middle class’ resources. For example, the purchase of private tuition is generally seen as a ‘middle class’ phenomenon (Smyth, 2009) through the deployment of economic capital, but many Indian and Chinese ‘working class’ students were found to be recipients, which may reflect their family views of educational success as a prerequisite for upward social mobility (*see* Chapter 6). However, Bourdieu’s class theory appears applicable in the context of social capital, particularly through the notion of *quality*, which was conceptualised to reflect the influences of different types of social network in shaping students’ science or career aspirations. Knowing someone *in* a particular field was considered to be of *higher quality* than knowing someone aspiring *to* a field, which represents a *lower quality* social capital. Students tended to have (‘first choice’) aspirations towards careers where they had *higher quality* social capital. The idea of capital as being *under-utilised* also emerged, which may challenge Bourdieu’s assumption that available resources are *always* maximised or converted for various advantages. Some students in the study appeared to possess but neglect (or resist) science-related social and/or cultural capital. In this chapter, Bourdieu’s concept of capital was applied to the experiences of minority ethnic students as a way to elucidate how and why some students formulated their career and science aspirations. The next chapter continues this line of enquiry through Bourdieu’s notion of habitus.

Chapter 6 – Habitus and the influence of family and educational discourses

Introduction

In Chapter 5, the influences of economic, social and cultural capital were examined in relation to students' science and career aspirations. However, Bourdieu (1977, 1986) conceptualised the notion of capital in relation to, and as part of, his broader theory of social class reproduction, which includes his notions of habitus and field (*see* Chapter 2). For Bourdieu, the habitus can be seen as the particular ways of understanding the social world that is shaped (and reshaped) by the past and present experiences of an individual, which are conditioned under various structural, societal and historical circumstances. Thus, the habitus represents the 'natural' ways in which one approaches the social world, through the capital available to an individual. This chapter uses the notion of habitus to shed light on the expected or taken-for-granted ways in which minority ethnic students aspired to or performed particular educational, science and career aspirations. In particular, the focus is on family discourses of education and how they can interact with the habitus to generate various practices amongst minority ethnic students.

The family discourse of 'valuing education' (Francis and Archer, 2005) is first examined as education appears to be valued across minority ethnic students in the study. However, within such educational discourse there seems to be a distinction between two discourses that Archer and Francis (2007) term 'being the best' and 'doing your best'. These two forms of educational practices are explored to shed light on two types of habitus: as 'achievement oriented' and as 'learning oriented'. The chapter concludes with an application of Bourdieu's notion of habitus in relation to the 'student science engagement' typology (*see* Chapter 4) and the notion of science capital (*see* Chapter 5).

The family discourse of 'valuing education'

Across the data from student focus group discussions (n=6) and individual interviews (n=46), there appeared to be a family discourse of 'valuing education' within the habitus of minority ethnic students, where education and educational

attainments were seen to be worthwhile, meaningful and important. The students were unanimous in the six discussion groups that their parents *all* valued education highly for intrinsic and/or extrinsic purposes. According to these students, typical views from parents on the importance of education included its value ‘for the future’, ‘for knowledge’ and ‘for a better life’, justifications which were also shared by students themselves. For example, Shane and JJ said in a discussion group of Black Caribbean students that their parents expected them ‘to learn, get the right education’ (Shane) and ‘get the right job’ (JJ). In this case, minority ethnic parents and students seemed to associate educational success with personal betterment.

In their individual interviews, many students in the study also expressed aspirations for a university education, which again suggests that the educational route was widely promoted (or expected) within their families. While previous studies found that ‘working class’ and minority ethnic groups viewed education or academic ‘success’ as ‘not for me’ (Archer *et al.*, 2003, 2007b), or even ‘acting white’ (e.g. Black Americans, *see* Ogbu, 2004), many students in this study – across gender, class and ethnic backgrounds – seemed to share a family discourse of ‘valuing education’, where education (and achievement) were valued, desired and sought after.

Although the majority of students claimed that their parents had educational aspirations for them to perform and achieve, such parental expectations varied individually. For example, Gina (11, F, Black Caribbean, Barton) said her mother only expected her to complete sixth form while Amy (13, F, Pakistani, Barton) appeared convinced that a university degree was the minimum educational qualification her parents expected her to achieve. Hence, even though both Gina and Amy appeared to share the family discourse of ‘valuing education’, where their families collectively viewed education as important, desirable or as a route for ‘success’, there remained a distinction between the ways in which Gina and Amy approached education.

Building on the notions of ‘being the best’ and ‘doing your best’ in education as suggested by Archer and Francis (2007, p. 142) in their study of British Chinese teenagers, the next two sections of the chapter explore how some students in the current study (particularly those from Pakistani, Indian and Chinese backgrounds)

appeared to inhabit within an environment where educational achievement was not just desired but also expected (e.g. ‘being the best’), and how other students (particularly those from Black Caribbean and Bangladeshi backgrounds) were socialised through the notion of ‘doing your best’. The educational discourses of ‘being the best’ and ‘doing your best’ can also shed light on the ‘student science engagement’ typology as proposed in Chapter 4.

Educational discourse of ‘being the best’ and ‘achievement oriented’ habitus

In this section, the notion of ‘being the best’ is explicated as a variant within the family discourse of ‘valuing education’, focusing on students’ perceptions of, and responses to, parental expectations and experiences. In Chapter 4, some students were categorised as having *engagement without interest or aspiration* in science because they were able to achieve in science despite their lack of apparent enthusiasm for the subject *per se*. Applying the theoretical tools of Bourdieu, it is suggested that these students possessed an ‘achievement oriented’ habitus, which enabled some students to perform in school science without science interest or aspirations. The desire of some students for top academic attainment is argued in this section as being facilitated through the educational discourse of ‘being the best’ (Archer and Francis, 2007), which can be seen as the functioning of an ‘achievement oriented’ habitus that ensures top achievements in education are seen to be the ‘natural’ or ‘correct’ pathway or prerequisite for later life.

A number of students, particularly those from Pakistani, Indian and Chinese backgrounds, appeared to view high academic achievement as ‘normal’ or expected within the family. In a focus group discussion with Chinese students, the importance of university education was explicated by Jane and Odele:

JANE: ... even though my mum didn’t say anything about becoming a doctor or lawyer, nothing, but she always say, ‘if you don’t study well you won’t be able to go to university, then you can be a beggar on the street’.

ALL: [LAUGHS]

ODELE: That’s what my dad used to say! ‘You can go to McDonald’s to wash toilets’.

JANE: Yeah, if I was watching the TV, she'll be like, 'go and study, if you don't go and study, you'll be a beggar', that's my mum.

According to Jane and Odele, their parents equate failure to 'study well' and 'go to university' with seemingly undesirable futures/careers, such as 'be a beggar' or 'wash toilets'. Success in education (e.g. admission to university), in this case, appeared to be constructed by Chinese parents as the *only* escape route from impoverishment. Indeed, in the same group discussion, the notion of 'never good enough' appeared to have emerged within students' narrative of parental expectations toward their educational attainments:

CHRIS: Even if you get like the top in your class, say if you got like 80% they'll say, 'oh you should have got a 100%'.

JANE: Your mum is like that?

CHRIS: Yeah, I got 80 marks, I got first place [pause] 'you have should have got 90 marks'.

JANE: Like if you get 75, or 80, like even if it's the highest in your class, then she's like, don't compare with those lower than you, compare with the high ones, that's what my mum is like, not my dad.

CHRIS: They want to see improvement, not reward.

In the extract above, Chris and Jane stressed that their parents were *never* satisfied with their educational attainments, even when they achieved 'first place', as their parents would then expect even higher or maximum grades. While Archer and Francis (2007) found the educational discourse of 'being the best' (as opposed to 'doing your best', see 'Educational discourse of 'doing your best' and 'learning oriented' habitus') to be prominent within the racialised boundaries of British Chinese families, the authors noted that some Chinese parents may be concerned that their children's educational success was "not yet secured" (p. 142), and thus continuous effort and achievement was considered necessary. As such, for Chris and Jane's parents, 'being the best' may not be measured according to their form class or even school, but in relation to the test and examination *per se*. Similar views were expressed in a discussion group with Indian girls, who complained about the lack of praise from parents:

SAMANTHA: But like they're only happy if you get like 100% or something [giggles].

BECKY: Like they make you feel bad just so to make you do better, but it never works!

SAMANTHA: Yeah, I just feel really bad cos I thought I did really good!

JENNY: It's like, cos, like, if we get a good mark every time, they won't praise us...if we get like a really good mark they will praise us for that one time.

SAMANTHA: That's what teachers do as well.

ALL: Yeah!

JENNY: Then like, at the same time, you're suppose to be doing it anyway so like, you shouldn't have to be praised anyway, it's like general thing that you should do...so you shouldn't really get praised for it.

ALL: Yeah!

Thus, this group of Indian girls also found maximum scores as the *only* desirable outcome from parents, where praise was warranted. However, the girls also acknowledged that achievements of a 'good mark' in their school work were normal and expected, as implied by Jenny at the end of the extract ('it's like general thing that you should do ... so you shouldn't really get praised for it'). While the Indian girls may also share the feeling of being 'never good enough', they seem to have internalised the need to perform academically, with or without parental praise, as something 'you're suppose to be *doing* anyway'. Thus, for the Chinese and Indian students above, the discourses of 'valuing education' and 'being the best' would construct high educational achievement as the norm ('first place', 'good mark') and desired ('improvement', '100%'), constituting an 'achievement oriented' habitus which some students in this study appeared to inhabit.

Similarly, the prospect of *not* attending university appeared unthinkable amongst some students. For instance, Amy (13, F, Pakistani, Barton) refused to accept the possibility of her educational disengagement before higher education:

INT: What do you think will happen if say to your parents: ‘I want to stop here, after secondary school’, what do you think they will say?

AMY: I wouldn’t say that, but if I did, erm, they would say like, I don’t know, I don’t know actually, I would never say that!

INT: What about if you say you don’t want to go to university?

AMY: They would be quite upset cos they would like me to obviously get a degree, but I’m definitely going!

For Amy, the route to university seemed to be normalised within her understanding of the social world, and failure to attend university may have been interpreted by her as deviation from her ‘normal’ or expected educational pathway. Although Amy’s views toward admission to higher education may reflect her ‘middle class’ background (Ball *et al.*, 2002b), students from ‘working class’ backgrounds – notably from Pakistani, Indian and Chinese backgrounds – also expressed similar family expectations for higher education.

From the only parental interview conducted, Narya, an Indian father, also expressed his expectations for his daughter Vincy (14, F, Indian, Cranberry) to attend university, to achieve highly and to ‘be something’:

I want her to do better, because I’m only a worker like, you know, so I want her to do her own thing, her own good, like, you know, I want her to do well, better than what I’m doing ... I want her to be something ... I want her to study for the full length you know when she can go to uni and finish her own education. (Narya, 54, M, Indian, Father of Vincy)

While previous studies have found that ‘white working class’ parents tend to possess ‘low’ aspirations for their children (e.g. Demie and Lewis, 2011), Narya has high aspirations for his daughter Vincy, despite coming from a ‘working class’ background (Archer and Francis, 2007).

Thus, Bourdieu’s theory of class reproduction through the habitus may be more applicable for the white population (Archer 2010, 2011), since studies of higher education with this group have found an ‘out of habitus/field’ experience whereby

‘white working class’ young people tend to reject university as a place for ‘people like me’ (e.g. Archer *et al.*, 2003). While recent studies by Reay *et al.* (2009, 2010) have found that the disjuncture between (mainly white) ‘working class’ habitus in ‘middle class’ institutions, such as (elite) universities, can be mediated through personal qualities such as ‘resilience’ and ‘coping with adversity’, some minority ethnic students in the current study (e.g. Mani and Norman, *see below*) are not in negotiation between the fields of ‘middle class’ higher education and ‘working class’ family environment. Rather, some minority ethnic students appeared to be following an expected route, even though such routes are not actually experienced by parents. Thus, the lack of knowledge or experience of higher education in the family history may render such routes as ‘unknown’ in personal experiential terms, but that does not necessarily mean such pathways are undesirable or unthinkable. However, it remains to be seen how the minority ethnic students in this study would experience the reality of higher education and whether or not their achievements will match their high aspirations. Archer and Francis (2006) suggested that some minority ethnic groups, such as the British Chinese, could inhabit an ‘aspirational’ diasporic habitus which reflects their unique experiences as minority ethnic migrants in Britain.

Although Bourdieu’s notion of habitus was conceptualised through the lens of class reproduction, it is suggested that minority ethnic students’ habitus could also be ‘responsive’ (instead of reproductive) to the habitus of their ‘working class’ backgrounds. As discussed below, an ‘achievement oriented’ habitus and the educational discourse of ‘being the best’ can be influenced by the lack of parental educational opportunities (*see* Archer and Francis, 2006), strict parenting and the notion of ‘family face’ (Zhou, 2005, 2009).

According to Mani, she expects and is expected (by her mother) to study medicine at a prestigious university. Although her mother was educated to secondary school level and was in receipt of welfare benefits, Mani acknowledged that the opportunity for education was a luxury unavailable to her parents:

Yeah, my mum wants me to be a GP and she wants me to go to Oxford University and she wants me to get a degree, cos they want me to be like really educated, so I can do something with my life, instead of them, they

haven't really done anything, not a good job, no degree, and no education, that's why. (Mani, 12, F, Pakistani, Barton)

The apparent lack of education opportunities and qualifications for Mani's parents seemed to have propelled their high aspirations for Mani to 'do someone with [her] life' through a university degree and a career in medicine. In this case, Mani's approach to education was not reproductive but responsive to the experiences of her parents ('they want me to be like really educated ... they haven't really done anything, not a good job, no degree, and no education') and the lack of parental opportunity and success may have itself been converted as a form of resource ('family capital', *see* Archer and Francis, 2006) that supported an educational discourse of 'being the best' within the family (e.g. she expects/is expected to go to Oxford University and be 'really educated'). Similarly, Norman claims that:

Our parents want us to get like A star, if we get like a B, they'll be like go away! They want us to get high grade so we can achieve something in life, like, they come from a poor, third world country, so they have achieved nothing and so they want us to achieve something more. (Norman, 12, M, Pakistani, Barton, Focus Group Discussion)

For students such as Mani and Norman, their educational discourse of 'being the best' may originate from the dearth of parental opportunities in education. Educational success (e.g. 'like A star') appeared to be constructed as a prerequisite for a successful life ('they want us to get high grade so we can achieve something in life'). For Bourdieu (1984), the 'working class' habitus would normally find 'middle class' institutions/establishments such as university or the medical field to be inhospitable due to their incompatibility of values, knowledge or understandings (e.g. 'fish out of water', *see* Chapter 2). However, the habitus can be shaped by the past as well as the present (Reay, 2004c).

For students such as Mani and Norman, their 'working class' backgrounds and 'middle class' aspirations may have been encouraged by the lack of educational opportunity available to their parents, which produced particular diasporic family and educational discourses such as 'valuing education', 'being the best' and 'high

status' career aspirations (e.g. the medical field), and provided students with an 'achievement oriented' habitus that may have operated beyond Bourdieu's theory of class reproduction.

Similarly, Modood (2004) argued that the high educational achievements amongst British Asian and British Chinese students were attributable to the family, which produces high aspirations and desires for upward social mobility. For Modood, awareness of the 'ethnic penalty' and the 'downgrade' of their social class position in British society due to migration (Platt, 2005) can generate a sense of 'injustice' which inspires minority ethnic parents and children to 'work harder' and improve their lowered social positions (Robb *et al.*, 2007). Indeed, some students (notably from Indian and Chinese backgrounds) in this study believed that their parents were stricter towards their education than those of their peers, or more specifically, parents of their 'white English'/'British' peers:

I think, there's a difference between, I'm not being racist, Asian and white people, erm, because white parents, white people parents, they want their child to be happy by doing whatever they want, but Asians want us to aim high ... they have high expectations for their children. (Ramos, 12, M, Indian, Cranberry School, Focus Group Discussion)

I reckon Chinese parents like push their child more and more strict, whereas people over here, people over here kinda, like, some doesn't really care, like, 'oh, she got a D, OK'. (Joanna, 14, F, Chinese, Yangtze)

According to Ramos and Joanna, Indian and Chinese parents 'have high expectations for their children' and 'push their child more', while 'white/English/British' parents are constructed through a discourse of 'the accomplishment of natural growth' (Lareau, 2003) where parents 'doesn't really care' about high achievement *per se* and just 'want their child to be happy'. Such perceptions, however, tend to be classed and pathologised onto white 'working class' parents (Sveinsson, 2009), which could suggest that the white peer groups of Ramos and Joanna were probably 'working class', or that their views of white parents simply reflected the wider constructions of white families through the lens of Indian and Chinese families (e.g. Archer and

Francis, 2007; Espiritu, 2001). Either way, Indian and Chinese students in the study appeared to construct their parents as stricter and having higher expectations than parents of their white peers, which, as argued below, may be related to the notion of 'family face'.

Zhou (2005, 2009) found in the context of Asian American (e.g. Korean and Chinese) communities that individual success (e.g. admission to Ivy League universities or 'high status' professions) can often entail his/her family members gaining 'face' within their local communities. Indeed, some students in the study also mentioned that being seen as 'good' or achieving academically can bring 'face' (e.g. respectability, admiration, honour, nobility) to the family. According to Tim:

If I'm good in my classroom then it means they're good parents, it's all like Bangladeshi people, if I go to someone's house and I'm good like, they'll be like, 'oh, he's the good one'. (Tim, 13, M, Bangladeshi, Everest)

Tim said he was aware that his performances in and out of school could shape how his parents were viewed by others, as 'good parents' or otherwise. Thus, if his performances were 'good' when he is at 'someone's house', then he would win approval (from members of the local Bangladeshi community) that 'he's the good one'. In relation to educational attainments, Pakistani students in a group discussion suggested that underachievement could lead to parental abandonment:

NORMAN: If you don't achieve yeah, and becomes a sweeper, your parents are like...

MANI: They don't want you!

NORMAN: Yeah, they just delete contact with you!

MANI: They just like, OK, goodbye!

AMY: Kick you out of the house.

NORMAN: They will change their address and change the locks and stuff.

ALL: [Laughs]

INT: So your parents expect a lot from you?

ALL: Yeah, a lot!

NORMAN: Basically, my mum say that ‘you have to be good’ and they tend to talk about you behind your back, I mean, like, they talk about us and if you’re bad, her reputation will be bad ... It’s like if you’re not good they won’t let you in the house.

According to Norman, Mani and Amy, Pakistani parents would abandon their children and eject them from the family house if they ‘don’t achieve’. From the extract above, the notion of ‘achievement’ and the imperative to ‘be good’ is positively related to ‘family face’ (or reputation), as underachievement (or ‘if you’re not good’) is equated with parental dismissal (‘They don’t want you’, ‘Kick you out of the house’). It is interesting to note that although these Pakistani students seemed to be making these statements of parental abandonment with a touch of humour, in a somewhat ‘comical’ and ‘exaggerated’ way (e.g. with laughter), the fact that it was a shared common ‘joke’ also underlines its prevalence and mutual recognition as a shared cultural discourse (*see also* Shah *et al.*, 2010). Similarly, the failure to achieve parental expectations could also lead to family humiliation, as suggested in a group discussion with Indian boys:

RAMOS: And also your parents might be like, ‘I’m gonna make my son become a doctor or lawyer’, and when you don’t, like your son doesn’t become that they become something like a rubbish cleaner or that, then that’d be like a huge-

ANDY: Shame-

RAMOS: Disappointment for them, and a big embarrassment cos they will like, say to everyone, ‘I’ll make my son become this and that’ and they don’t become that...

As can be seen from the extract above, the notion of ‘family face’ can contribute towards the educational discourse of ‘being the best’ through the recognition by students that educational/occupational ‘failure’ (or ‘success’) was not just an issue for the individual (e.g. students themselves) but also represented the ‘face’ of the family. Thus, Ramos and Andy agreed that Indian children could bring ‘big embarrassment’ to their parents should they fail to accomplish what their parents had expected them to achieve. This finding supports the work of Archer and Francis

(2007) who found ‘family face’ to be a powerful and motivating social practice that helps to facilitate high academic success amongst British Chinese students.

This section has proposed an ‘achievement oriented’ habitus as being facilitated by the educational discourse of ‘being the best’. Students’ responses to parental expectations and experiences, such as the lack of parental educational opportunities, strict parenting and ‘family face’ were discussed in relation to students’ approaches to education. For some students, high educational achievement may be interpreted as something ‘people like us’ *do*, which could provide explanation for why some students appeared to engage and achieve in science despite their apparent lack of interest or aspirations (*see* ‘Habitus, capital and the ‘student science engagement’ typology’ and Chapter 4). In this study, students from Pakistani, Indian and Chinese backgrounds appeared most likely to inhabit an ‘achievement oriented’ habitus. The following section will discuss the educational discourse of ‘doing your best’ and the notion of ‘learning oriented’ habitus.

Educational discourse of ‘doing your best’ and ‘learning oriented’ habitus

The educational discourse of ‘doing your best’ is examined in this section, which is argued to inform a ‘learning oriented’ habitus. In a similar vein to the educational practice of ‘being the best’, the philosophy behind ‘doing your best’ also values education and educational attainments (Archer and Francis, 2006). The key difference, however, is that the former is interested in the *outcome* while the latter place emphasis on the *process*. As argued in this section, the educational discourse of ‘doing your best’ can facilitate a habitus that is ‘learning oriented’, where it is ‘normal’ for students to focus on the process of learning, rather than the actual outcomes from learning (e.g. achieved grades). It is important to note that students with an ‘achievement oriented’ habitus may also empathise with the process of learning, even though the actual outcomes are also (if not even more) important. Thus, students who resided within a ‘learning oriented’ habitus would tend to view high educational outcome as desirable but not necessary expected, but education *per se* is highly valued. Many students from Black Caribbean and Bangladeshi backgrounds in the study seem to reside within a ‘learning oriented’ habitus that is informed by the educational discourse of ‘doing your best’.

In a discussion group with Black Caribbean students on the educational and occupational expectations of their parents, the importance of learning was made explicit by JJ and Stacey:

INT: What do they [parents] expect from you?

SHANE: To learn, get the right education.

JJ: Get the right education, get the right job, do GCSE.

STACEY: Just to learn.

Unlike, as discussed earlier, many Pakistani, Indian and Chinese students, who said that their parents were *never* satisfied with their educational outcomes, there were no references to parental expectations of academic grades or achievements throughout the discussion group with Black Caribbean students. In the extract above, expectations from Black Caribbean parents were understood by students through the notion of learning and getting the ‘right education [and] right job’. While students who share the educational discourse of ‘being the best’ tend to have parents who *expect* the top grades, the Black Caribbean students above appeared to share the educational discourse of ‘doing your best’, where emphasis from parents seemed to be on the process of learning, as opposed to the result from learning (e.g. the outcome).

Indeed, Shane (11, M, Black Caribbean, Barton) said in his individual interview that his parents were happy with his current grades (which are level 3s – a ‘low’ achiever, *see* Chapter 4) and progress and that they are ‘100%’ involved in his education. On the expectations of his parents toward his education, Shane noted *desirable* but not *expected* grades:

INT: In terms of education, what do you think they expect [parents] from you?

SHANE: To be at a good level, grades.

INT: What would good level be?

SHANE: Top, like 6s, A-stars.

INT: Do they expect you to get A-stars?

SHANE: They don't mind, if I got something high, not A-star, then they're fine, but not low, like Fs.

According to Shane, his parents did have very high educational expectations for him, but they 'don't mind' if he did not achieve the highest grade band, as long as it was 'not low, like Fs'. A number of students from Black Caribbean and Bangladeshi backgrounds also shared the view that their parents were generally pleased or satisfied with their progress, even if those grades were below the expected grades for students in their respective year groups (DCSF, 2002, *see* Chapter 4). In this case, parental aspirations informed through the educational discourse of 'doing your best' may have framed expectations through the desirable (as opposed to the expected) lens.

It was mentioned earlier that aspirations for university were common amongst the students in the study. For those who shared the educational discourse of 'being the best', the university pathway may have been seen as 'normal' and/or expected. However, for students who shared the educational discourse of 'doing your best', higher education was desired but not necessarily expected (but also thinkable). This is because parental expectations for students such as Gina (11, F, Black Caribbean, Barton) seem to have focused on *process* rather than *outcome*:

INT: Are your parents happy with your progress?

GINA: My mum's happy.

INT: Did they say you could or should do better in this or that?

GINA: Once I tried my best, there is nothing more I can do.

This response from Gina suggests that parental expectations or aspirations for her were limited to her ability and effort, where 'once I tried my best, there is nothing more I can do'. Related views were expressed by Tim (13, M, Bangladeshi, Everest), who said that his parents 'don't mind if I'm average, but they want me to be the best I can be'. Students such as Gina and Tim seem to share the educational discourse of 'doing your best' in which their parents would expect them to try and fulfil their personal potential by 'doing your best'. Thus, the educational discourse of 'doing your best' can be seen as facilitating a 'learning oriented' habitus where the

normative practice is concerned with the *process* as opposed to the *outcome* of educational learning. Students with a 'learning oriented' habitus were more likely to associate with the common phrases 'making the effort', 'giving it all' and 'trying your best' than students with an 'achievement oriented' habitus, where top educational outcomes and 'being the best' constituted the expected views (e.g. 'never good enough', *see* earlier section). In this case, it may be 'normal' for students with a 'learning oriented' habitus to have *desirable* outcomes through the *process* of 'doing your best'.

In her longitudinal qualitative study of parenting strategies, Lareau (2002, 2003) conceptualised the notions of 'concerted cultivation' as typical childrearing practices of 'middle class' families and the 'accomplishment of natural growth' as exemplary of 'working class' parenting. In line with Bourdieuan theory, concerted cultivation refers to children who are socialised with a sense of entitlement and who participate in a range of 'valued added' activities carefully organised by their parents to maximise their education. The strategy understood as the 'accomplishment of natural growth' refers to children who are socialised 'naturally' without deliberate or particular emphases from parents. The latter strategy can be seen as related to the educational discourse of 'doing your best', because parental expectations reflect the efforts or desires of children/students, rather than specific outcomes (e.g. 'being the best') or parental ideologies (e.g. concerted cultivation). For example, Saiyef (13, M, Bangladeshi, Everest) explicates that his parents 'just want me to choose what job I want to get' as his 'mum says it should be best if I choose what I want'. Likewise, Florence (12, F, Pakistani, Barton) said that her parents 'don't tell me to be something but just be something I want to be'. Some students, such as Kyle (14, M, Bangladeshi, Everest), even admits that they are unaware of any expectations their parents have for them:

INT: Do you know what your parents would like you to do in the future?

KYLE: Erm, don't know really, I don't really ask my mum or dad.

INT: Have they ever mentioned to you what you could become in the future?
Any jobs they think it's good for you?

KYLE: No...my mum just thinks just do what you want to do.

INT: And your dad?

KYLE: It's the same.

From the extract above, Kyle openly acknowledges that he does not know the expectations of his parents for him and that he has not discussed the issue of future careers with them. Such views appear consistent with the parenting practice of the 'accomplishment of natural growth', whereby children are *encouraged* to develop their own ideas through the *lack* of parental interventions and expectations. Like Saiyef and Florence, Kyle also suggested that his parents would want him to choose his own career. As such, students like Saiyef, Florence and Kyle appeared to reside within a family environment where career or educational aspirations reflected the choices of individual students as to the specific expectations of their family members. Likewise, parental aspirations for these students were also vague because no specific outcomes were expected, since the emphasis was placed on student effort and on the process of learning. Thus, a 'learning oriented' habitus facilitated through the educational discourse of 'doing your best' and informed by the parenting style of 'the accomplishment of natural growth' may have enabled students with the 'natural' view that 'I [can] choose what I want' to do by trying 'my best'.

Although the childrearing practice of the 'accomplishment of natural growth' was argued to reflect a 'working class' practice (Lareau, 2002, 2003), the influence of class is unclear in relation to those who share the educational discourses of 'doing your best' and 'being the best'. Rather, differences in minority ethnic background seemed to differentiate students' approach to education. Black Caribbean and Bangladeshi students seemed to dominate those who inhabited a 'learning oriented' habitus that was informed through the educational discourse of 'doing your best'. However, while Lareau (2002, 2003) found 'working class' children socialised through the 'accomplishment of natural growth' often developed a sense of constraint, such notions (e.g. 'know your place/limit') were not apparent across the students in this study, at least in terms of aspirations and what is considered thinkable, possible and achievable (*see* Chapter 4). Thus, even though some students may have shared the parenting style of 'the accomplishment of natural growth', these students did not necessarily share the sense of constraints as experienced by the children in Lareau's (2002, 2003) research, since the educational discourse of 'doing

your best’ aligned with the view that success is achievable through hard work (e.g. meritocratic views).

In the previous section, the lack of parental education opportunity was suggested to inform the educational discourse of ‘being the best’, enabling the habitus of some minority ethnic students to be responsive to the experiences of their parents and thus ‘achievement oriented’. However, the influences of parental experiences and expectations (e.g. lack of parental education opportunity, strict parenting and ‘family face’) seemed less apparent across the data transcripts of students who appeared to share the educational discourse of ‘doing your best’ and a ‘learning oriented’ habitus.

In this section, the educational discourse of ‘doing your best’ was suggested to inform a ‘learning oriented’ habitus in which the normative view towards education was on the *process* of learning as opposed to the *outcome* from learning. In other words, top educational achievement may be desired but not expected amongst students influenced by the educational discourse of ‘doing your best’. Indeed, the apparent dominance of Black Caribbean and Bangladeshi students who possessed a ‘learning oriented’ habitus may shed light on their tendency to be categorised with *low*, *wishful*, *ideological* and *medium engagements* in science (see Chapter 4), because the educational discourse of ‘doing your best’ emphasises *desirable* as opposed to *expected* outcomes. In support of an ‘aspiration-achievement paradox’ (DeWitt *et al.*, 2011a; Mickelson, 1990), these students may be socialised and encouraged to aim high, even if such aspirations may be ‘out of reach’.

Habitus, capital and the ‘student science engagement’ typology

From a Bourdieuan perspective, science and science-related careers would normally constitute a ‘middle class’ profession that may be undesirable or unthinkable for those who share a ‘working class’ habitus (e.g. Adamuti-Trache and Andres, 2008). However, the capacity of many minority ethnic ‘working class’ students in the current study to possess career aspirations considered as ‘middle class’ (e.g. science-related, see Chapter 4) might have been made possible through the racialised family discourses of ‘valuing education’. As discussed earlier, the importance of education was apparent across the transcripts of student interview and focus group discussion

data. The value of education for intrinsic and/or extrinsic purposes appeared widely acknowledged by students in the study and educational ‘success’ seemed to be highly sought after, even if there were differences between those who sought after ‘being the best’ and those who aspired ‘doing your best’. The educational discourse of ‘being the best’ was argued to inform an ‘achievement oriented’ habitus while the educational discourse of ‘doing your best’ was argued to inform a ‘learning oriented’ habitus. Drawing on the notion of science capital (*see* Chapter 5) and the categories of ‘student science engagement’ (*see* Chapter 4), this section applies Bourdieu’s notion of habitus in the field of science by examining the extent to which the scientific route may constitute a ‘natural’ pathway for minority ethnic students.

Similar to the ethnic disparity found amongst students who appeared to share the educational discourses of ‘being the best’ and ‘doing your best’, Chapter 5 also found comparable patterns amongst minority ethnic groups in relation to their science capital. In terms of economic capital, which was investigated through the provision of private tuition, the majority of recipients were Indian and Chinese students. The three perspectives identified in Chapter 5 (*demands from parents for higher grades, demands from students for higher grades and culture of private tuition*) to explain why these students received private tuition appeared to align with the educational discourse of ‘being the best’, where better or top academic grades were sought after. For instance, students embedded within a *culture of private tuition* appeared to share a family environment where out-of-school learning is normal (i.e. as part of the habitus). Similarly, the perspective *demands from students for higher grades* seemed to support an ‘achievement oriented’ habitus as students themselves were striving for higher educational attainments (e.g. ‘being the best’). Thus, the dominance of Indian and Chinese students who received private tuition was consistent with an ‘achievement oriented’ habitus which many Indian and Chinese students also seem to occupy.

Many students in the study also seemed to command some form of social and cultural capital related to science, which would in theory support a habitus that viewed the scientific career route as possible and thinkable. However, a distinction was suggested in Chapter 5 between *higher quality* and *lower quality* forms of science social capital, where the former entailed knowing someone *in* the field of

science and the latter referred to knowing someone with aspirations *to* the scientific field. Although a classed difference emerged in support of Bourdieu's social class reproduction theory in relation to the possession of *higher quality* science social capital (see Chapter 5), there were also notable differences amongst students within the 'Asian' groups. While many Indian students with science-related career aspirations seemed to possess a range of *higher quality* science social capital, most Bangladeshi students with career aspirations in a science-related field only seemed to have *lower quality* social capital related to science. Although such a distinction may reflect the dominance of Indian students being categorised with *high engagement* in science and Bangladeshi students being categorised with *wishful* and *ideological engagements* with science (see Chapter 4), it may also be understood through the different family discourses of 'valuing education' in which many Indian (e.g. 'being the best') and Bangladeshi students (e.g. 'doing your best') seemed to inhabit (see earlier).

For instance, the educational discourse of 'doing your best' (which informs a 'learning oriented' habitus) is concerned with the *process* of learning through *desirable* (and not actual) outcomes, which is consistent with the categories of *wishful* and *ideological engagements* with science, since actual achievements (e.g. achieved grades) are irrelevant in students' formation of science/career aspirations (e.g. 'achievement-aspiration paradox', see Chapters 4 and 5). In this case, an 'achievement oriented' habitus would appear inconsistent with *wishful* and *ideological engagements* with science because actual outcomes (e.g. top grades) constituted a fundamental element of the educational discourse of 'being the best'. Indeed, students categorised with *engagement without interest* or *aspiration* in science (see Chapter 4) would appear to have shared an 'achievement oriented' habitus because these students would theoretically strive for academic achievements even if they lacked personal interest or aspirations in the subject *per se*. The majority of students with *engagement without interest* or *aspiration* in science were Chinese and from 'working class' backgrounds (see Chapter 4), which reflected the tendency of Chinese students to possess an 'achievement oriented' habitus (see earlier). Thus, students with *engagement without interest* or *aspiration* in science were able to view top achievements as 'normal' and expected, despite their 'working class' backgrounds, because their aspirations to succeed educationally may have

constituted a response to their family history and experiences (e.g. lack of parental education opportunity, strict parenting and family face). Thus, the notion of ‘family capital’ may be a useful concept as a means to account and encompass the resources available to students arising out of specific family histories, experiences or events (e.g. Archer and Francis, 2006).

As mentioned in Chapter 5, although many students mentioned that their parents had aspirations for them to excel in careers related to medicine, finance and law, there was a notable exception amongst Black Caribbean students, who tended to say that their parents had no particular expectations for them. The apparent lack of parental expectations or desires amongst the Black Caribbean group may reflect a ‘learning oriented’ habitus which many Black Caribbean students seemed to occupy. The educational discourse of ‘doing your best’ may encourage students to develop their own ideas and aspirations without parental interruptions. Thus, Black Caribbean students categorised with *low engagement* in science (see Chapter 4) may have limited exposures to science from their family (e.g. their experiences of science may be restricted to the school domain). However, it is worth mentioning that not all students categorised with *low engagement* in science necessarily shared a ‘learning oriented’ habitus and the educational discourse of ‘doing your best’.

Some students, such as Amy (13, F, Pakistani, Barton), have ‘high status’ aspirations and ‘high’ achievements in non-science-related fields. As the only ‘middle class’ student categorised with *low engagement* in science (see Appendix 10), Amy had career aspirations in the fashion industry. Although she was in the ‘bottom set’ for science in her year group and had a ‘low’ level of science interest (see Chapter 4 and Appendix 11), Amy was in the ‘top set’ for English and aspired to be in the ‘top set’ for maths (at the time of the study, she was in a ‘middle set’). Thus, Amy may have inhabited an ‘achievement oriented’ habitus even though her attainments in science *per se* were considered ‘low’ (level 5 for Year 9, see DCSF, 2002). Amy had a ‘medium’ level of science capital and said that her father had a science-related degree and worked in a science-related profession (i.e. the aviation industry). Indeed, Amy reported that her mother called her father ‘a science nerd’. Yet, Amy does not seem to share the same enthusiasm for science as her father.

In theory, Amy's father should have provided Amy with science cultural capital and even a science family habitus (*see Archer et al., 2012*) where science careers or educations are socialised as thinkable or even 'normal'. However, the transmission of parental science capital or the formation of a science-oriented habitus did not appear to materialise for Amy, whose science capital may have been *under-utilised* (*see Chapter 5*). Amy's aspirations for a career in fashion, on the other hand, appeared to be supported by *higher quality* social capital (related to fashion) as she drew inspiration, support and advice from her family, extended family members and peers – all of whom may have portrayed careers in fashion for Amy as 'normal', desirable and achievable. Indeed, the gendered facets of Amy's habitus may also have been competing here since science is widely considered a masculine field (Baker, 1998; *see Chapter 1*) whereas fashion tends to be feminised in mainstream society (Hauge, 2009). The notion of science as gendered, classed and racialised is explored in the next chapter through the lens of identity.

The case of Amy has demonstrated the fluidity amongst the types of 'student science engagement' (*see Chapter 4*), the notion of capital (*see Chapter 5*) and the educational discourses of 'being the best' and 'doing your best' (*see earlier*). Although this chapter has reported particular patterns amongst minority ethnic groups and their tendencies to share an 'achievement oriented' or a 'learning oriented' habitus, it is important to recognise the diversity which can also exist between students who appear to share similar practices and approaches to education.

Summary

This chapter has argued that the family discourse of 'valuing education' was shared by students across minority ethnic backgrounds. A distinction was proposed between the educational practices of 'being the best' and 'doing your best' within the family discourse of 'valuing education'. The former was suggested as informing an 'achievement oriented' habitus where achievements and expectations of top grades or careers become 'normal' and expected (e.g. 'being the best'). The latter was argued to facilitate a 'learning oriented' habitus, which emphasises the process of learning through continuous effort (e.g. 'doing your best'). Drawing on the 'student science engagement' typology developed in Chapter 4, students categorised with

high engagement and *engagement without aspiration or interest* in science would appear to have possessed an ‘achievement oriented’ habitus. Students categorised with *wishful* and *ideological engagements* in science may have been informed through a ‘learning oriented’ habitus.

While Bourdieu’s notions of habitus and capital were tested in this chapter (and in Chapter 5) to provide some explanations for the ways in which minority ethnic students develop their educational, science and career aspirations, Bourdieu’s theory does not explicitly address the notion of identity which existing studies in science education (e.g. Brickhouse and Potter, 2001) have argued to be conceptually significant (*see* Chapter 2). Thus, the following chapter will go beyond Bourdieu’s social class reproduction theory and explores the conceptual purchase of identity theories in relation to science.

Chapter 7 – Gender, ethnicity, class and ‘science identity’: Dis/identifying and negotiating a relationship with science

Introduction

As discussed in Chapter 2, identity can be understood as an ongoing project of constructions and performances, constituting a continuous process of negotiation within complex structural and agentic relationships (Butler, 1999). Identity can be seen as fluid and as always ‘in process’ (Hall, 1990), conditioned under multiple and unsteady social and structural forces. Previous studies (*see* Chapters 1 and 2) have suggested that gender, class and ethnicity can shape students’ views of science because the popular images of scientists and science are typically seen as a field of, and for, the archetypal ‘white middle class men’. In other words, ‘white middle class men’ may constitute the normative group within the science field and thus the identities of minority ethnic pupils may appear (or be considered, *see* Chapter 8) as inconsistent with the popularly perceived characteristics of scientists/science (e.g. that is, as ‘white middle class and male’).

In this chapter, the notion of identity is explored through the ‘science identity model’ as developed by Carlone and Johnson (2007), who argued that identities of gender and ‘race’/ethnicity can shape students’ performance, recognition and identity in science (*see* Chapter 2). Thus, the ways in which minority ethnic groups identify with science as a field for ‘people like me’ are investigated, focusing on how minority ethnic students negotiate gender, ethnic and class identities in relation to their identifications with science. Drawing on student interview transcripts, the discourses of science as ‘for men’, as ‘for white people’, as ‘oriented towards the middle class’ and as ‘for anyone’ are explicated. The next chapter continues this line of enquiry and focuses on students’ construction of science as ‘for clever people’, how minority ethnic groups are recognised by their science teachers and the relevance of ‘science identity’ for minority ethnic students.

Science and gender: A masculine field?

In this section, the relationship between gender and science is explored through the popularly voiced discourses of science by students as ‘for men’ and/or as ‘gender equal’. The tensions between ‘gender stereotyped’ (i.e. ‘for men’) and ‘gender equality’ discourses of science are also discussed. The majority of students (29 out of 46) in the study expressed ‘gender stereotyped’ views toward the science field. For example, Amy (13, F, Pakistani, Barton) suggested that ‘science is more manly-ish’ and her views of science were understood as ‘gender stereotyped’, that is, reflecting the discourse of science as ‘for men’. Although some students may have expressed ambiguous or contradictory views of science and gender (e.g. with ‘gender stereotyped’ *and* ‘gender equal’ views of science, *see* examples of Jenny and Mani later), a minority of students (17 out of 46) seemed convinced that ‘any gender can be scientists, doesn’t really matter’ (Aaron, 11, M, Chinese, Yangtze). Students with views of science as ‘gender equal’, it is argued, were informed through egalitarian discourses of science as ‘for anyone’.

As has been reported before (e.g. Blickenstaff, 2005; Hill *et al.*, 2010), scientists and science as a field of enterprise continue to be associated with men and masculinity. Many students in the study – across gender, class and ethnicity (except Chinese students) – seemed to share the discourse of science as ‘for men’ and viewed science as masculine and male-dominated (*see* Chapter 1). The data collected provides no clear explanations for the deviation of Chinese students – this is an opportunity for further research. For example, Ronnie (14, M, Bangladeshi, Everest) claimed that most scientists were men because ‘men take the risk and women don’t’ and Samantha (13, F, Indian, Cranberry) speculated that most girls would probably think that science was ‘dominated by boys, so there’s no point doing it’ and that girls ‘just want to do something girly’. In this case, the discourse of science as ‘for men’ may encourage the self-exclusion of some girls from career aspirations in the science field (Ceci and Williams, 2007). Thus, the male-dominated science field can be unattractive for some girls, who may lack self-belief in their abilities in science or may prefer ‘something girly’ (*see* later this section).

Kyle (14, M, Bangladeshi, Everest) hypothesised that the lack of female scientists was because ‘women probably, like, don’t want to, like, look up to a man, like, want to look up to another woman as well’. Kyle seems to take for granted that scientists are men, as the norm, and asserted the possible dilemmas of girls having male scientists as their role models or superiors. Jenny also stated the potential benefits of female scientist role models for girls:

If there was like a woman at the top, girls might get encouraged and say ‘oh look, there’s a women at the top, I could do that as well’ so then they might think, ‘Yeah, girls can be scientists’. (Jenny, 13, F, Indian, Cranberry)

For Jenny, the visible success of women in science (‘look, there’s a women at the top, I could do that as well’) was imagined to open up the science career pathways into possible and achievable domains amongst girls (Häussler and Hoffmann, 2002). Such views align with the popular assumptions of many science initiatives and interventions designed to encourage girls’ participation in science through the use of female role models who are already in the science field (e.g. UNESCO, 2007). However, recent studies have also argued that the influence of female scientist role models may be limited in shaping girls’ aspirations towards science careers (Gilbert and Calvert, 2003; Gilmartin *et al.*, 2007; Royal Society, 2004). As implied in Chapter 5, public role models in science would constitute a *lower quality* science social capital as students are unlikely to know them on a personal level. Thus, such form of science interventions may need to place more emphasis on interpersonal relationships (Sjaastad, 2011). For example, Buck *et al.* (2008) found girls (aged 13-14) to associate and accept female scientist role models only after personal connections and relationships were established.

The discourse of science as ‘for men’ constitutes a gender discourse of ‘traditional’ roles and stereotypes, which consequently positions women as ‘unsuitable’ candidates in science (Baker, 1998). For instance, Donald (11, M, Chinese, Hakka) believed careers in science were ‘not good for women, it doesn’t suit their kind’. When asked what jobs suits ‘their kind’ (i.e. women), Donald replied ‘easy ones, something like housework or typing’. The positioning of women by Donald within the home sphere also aligns with students’ construction of women as typically

housewives. Saif (12, M, Pakistani, Cranberry) and Aaron (11, M, Chinese, Yangtze) explained that the lack of female scientists was due to women being busy ‘looking after children’ at home. In a group discussion with Indian girls, the ‘gender traditional’ roles of women appear to be widely shared and acknowledged:

BECKY: I haven’t really heard of the female ones [scientists], maybe it’s because women have to cook all the time.

VINCY: Yeah, they’re mostly housewives.

BECKY: And put the dishwasher on.

In the extract above, women were constructed as ‘mostly housewives’ who ‘cook all the time’ and ‘put the dishwasher on’. The comments from Becky and Vincy appeared to reflect discourses of ‘gender traditional’ roles where women tend to be situated within the family, occupied with domestic duties. In her individual interview, Becky (13, F, Indian, Cranberry) suggested that girls might think of science as ‘a men’s field and then they [girls] don’t like to push themselves ‘cos they don’t believe it, kinda like me’. It is perhaps surprising that young girls such as Becky and Vincy draw on discourses of women as ‘mostly housewives’ given that contemporary literature (e.g. Francis, 2002; Sikora and Saha, 2009) on gender and aspirations reports girls as aspiring towards professional careers and shared gender equity views where men and women can “do any job they wanted to these days” (Tinklin *et al.*, 2005: 129). Interestingly, both Becky and Vincy have expressed aspirations in professional careers, to be a pharmacist. Thus, although Becky and Vincy draw on traditional discourses of women as ‘mostly housewives’ to explain for the apparent lack of females in science, their own science-related career aspirations appear unaffected and may have been facilitated by other discourses they were able to draw upon that encouraged professional or science career aspirations (e.g. an educational discourse of ‘being the best’, *see* Chapter 6).

The ‘unsuitability’ of girls in science was elaborated by some students through the stereotypes of girls as only interested in fashion and makeup, or ‘something girly’. According to Norman:

[I] don't think any girls wants to be a scientist ... 'cos basically they want to be in the latest gossips and stuff like that, fashion ... celebrities ... so basically they don't really care about science that much. (Norman, 12, M, Pakistani, Barton)

Such views, however, may be challenged by some feminists who are critical of the dominant constructions of science as male and masculine, which tend to (re)produce women as subordinates in the science field and of femininity as inherently heteronormative and 'trivial' (Harding, 1991). For boys such as Norman, girls do not invest in science as their interest aligns with feminine-oriented domains, such as fashion (Hauge, 2009). Similarly, Ralph (13, M, Bangladeshi, Everest) believed that girls 'don't like science ... [they] like design and stuff' and Jube (M, 11, Bangladeshi, Barton) claimed that girls 'like more [finger] nails and that, Body Shop, like clothes and all that stuff'. In this case, girls may be constructed by some boys through the practice of 'girling' (Butler, 1993), or the desire to perform hetero-femininity. A 'science identity' for girls, therefore, may not be recognised by boys in the classroom. Indeed, Archer *et al.* (2010b) found young boys (aged 10-11) had vested interest in constructing 'high status' subjects as masculine, such as science, as some boys appear to police and reproduce the gendered boundary of science as 'for men' by pathologising girls as (only) interested in fashion and thus not 'naturally' into science.

Interestingly, some girls in the study also seemed to share the view of 'girling' (Butler, 1993) when explaining the lack of females in science. For instance, Holly (12, F, Chinese, Yangtze) suggested that 'women are more into fashion and cooking, but, it's mainly men [in science], 'cos I haven't really seen any women'. Her views echo 'gender stereotyped' discourses and support the discourse of science as 'for men' since the interests of girls were framed through the lens of 'girling' and feminine-oriented domains (e.g. fashion), which would position girls as challengers, rather than as successors (like boys), in the science field. Similarly, Fay (13, F, Bangladeshi, Barton) distanced girls' involvement in science by suggesting that 'girls are more into how they look, and not really into education and stuff, care about make-up and stuff', which seem to align with her own interest in hetero-feminine performativity and ambitions to become 'famous' (Kelly, 1985; Walkerdine, 1989).

Fay's interest in hetero-femininity was also evident in science classroom observations (4 hours), which noted Fay to be checking her appearance on a regular basis:

Fay continues to check her make-up as Mr Tallman [her science teacher] walks away from the table, and she began applying lip gloss. Fay passes her lip gloss to her friend, who held but did not use it. Fay continues checking her make-up holding a small mirror, and applies a few brushes to her face, as well as talking to the other girls at the table. Fay frequently checks her make-up. Fay then applies mascara covertly, most probably after her nail varnish was confiscated by Mr Tallman. (Observation note, November 5th 2009)

Fay appears to invest considerable time in her hetero-feminine appearance in science lessons, and such performances appear to be supported within her peer group, reinforcing her performative identity (and doings) of 'girling' (Butler, 1993). Fay's construction of a desirable female identity appears to revolve around her ambitions to be in the entertainment business and the performances of hetero-femininity. Although Fay's science teacher, Mr Tallman, regarded her as competent enough to study science at the highest level for GCSE (i.e. triple science), he felt the likelihood of Fay opting for triple science was extremely low, because he saw little or no interest from her in science. Mr Tallman commented that:

It's a little early days to say which ways she swings at the moment ... I would like to get her more interested ... [but] I honestly think with someone like her, I would probably fail in trying to get her interested ... but she's doing OK because that's what she's got to do, not necessarily because she's inspired to do it. (Mr Tallman, 37, M, White English, Barton)

According to Carlone and Johnson (2007), recognition by others, as well as self-recognition, constitutes the key elements of a sustainable 'science identity'. If students, such as some girls in this study, are unable to self-recognise, be recognised by others (e.g. science teachers, *see* Chapter 8) or imagine that others would recognise them (i.e. self-other positioning) as a 'science person' in school, then their performances of 'science identity' are likely to be undermined, undesired and/or

unsuccessful. For Fay, a 'science identity' may be seen as inconsistent with her desire to be 'famous', which reflects her performances of femininity and 'girling', since her views of science seem to draw on the discourse of science as 'for men'.

The construction of science as overtly masculine was elaborated by Shane (11, M, Black Caribbean, Barton), who suggested that science 'should be more for men 'cos, like, sometimes you can get hurt by things' and expressed that his own ambition to be a scientist could potentially 'save women'. For Shane, men were more suited to scientific work as women can 'get hurt' in science. Shane's construction of women as subjects in need of saving by men (through masculinised/heroic professions such as a scientist) positions men as rightful figures (and women as unsuitable candidates) in science. Indeed, his reference to danger and saving women seems to align with the concept of 'hegemonic masculinity', as Shane reinforces the "dominant position of men and the subordination of women" (Connell, 1995: 77) in relation to science. For some students then, science/scientific values *are* the values of masculinity, which are incompatible with femininity. Indeed, international studies have found that the masculine nature of science and science-related careers can be unattractive and undesirable for many girls (e.g. Christidou, 2006 in Greece; Jones *et al.*, 2000 in US; Liu *et al.*, 2010 in China; Masnick *et al.*, 2010 in UK).

For many students, the discourse of science as 'for men' can be seen as facilitated, shaped and reinforced through the media, where men constitute the normative gender in popular representations of science/scientists (Baker, 1998; Chimba and Kitlinger, 2010). Indeed, the imagery of male scientists was so deeply imbued within students' conceptualisations that Samantha said she would feel 'quite weird' if she encounters scientists who were *not* men:

If it's a cartoon or something, you'll always definitely have a male scientist and if it was a female one I think it would be quite weird ... anything that you watch or see, you'll always see a male scientist, you won't ever see a female one ... if a TV programme did have a female scientist, you kinda think it's a bit weird. (Samantha, 13, F, Indian, Cranberry)

For students such as Samantha, female scientists or presenters of science (e.g. on television) are rare ('you won't ever see a female one') because it challenges the conventional image of science ('you'll always see a male scientist'). Samantha's use of the word 'weird' can shed light on the power of traditional gender discourses about science, where the conflation of female *and* science was interpreted by Samantha as unusual and unsettling. Indeed, the comments from Samantha were shared by many students who assumed men to be the default gender of scientists and science (Baker, 1998). For instance, Joanna (14, F, Chinese, Yangtze) stressed that scientists 'on television, it's always male', and even though 'sometimes they have like a leading female', she 'always just imagine them to be males'. Likewise, Amir (14, M, Bangladeshi, Everest) suggested that 'the presenters and scientists are always men' in the media. Such findings support existing literature which found students' construction of science/scientists to have changed little over the last few decades, as science continues to be popularly associated with men, despite increased media effort to use more women scientists/science presenters and the various science interventions which aimed to promote gender equity (Christidou *et al.*, 2010; Losh *et al.*, 2008). In this case, a 'science identity' may be challenging for girls as the dominant gendered discourse of science positions men as the norm and women as the other.

Although many students drew on 'gender stereotyped' views of science which privilege men, a minority of students (17 out of 46) expressed *only* 'gender equal' discourses in their perceptions of science. Rob (12, M, Black Caribbean, Davidson) asserted that 'girls get the same amount of education as boys ... we're in the same class so it wouldn't really make any differences'. Such views align with egalitarian discourses of science as 'for anyone', because gender is not seen to be a factor causing, or contributing to, patterns of inequality in the science field (Wyer, 2003). For students such as Gigi (11, F, Chinese, Yangtze), the suggestion of science as male-dominated was considered to be 'sexist', because 'women can be anything that they want, they can do the same thing as men'. Gigi recognised, but also rejected, the circulation of traditional gender discourses and claimed people 'probably think that women just have to stay at home and do like housework and stuff, but they don't really have to'. In this case, Gigi utilised the discourse of science as 'for anyone' and successfully refuted traditional gender discourses of women as typically housewives.

For some students, the science field is ‘gender equal’ as ‘any gender can be scientists’ and that a ‘science identity’ may not be associated with gender. The views of these students may be heartening for those who promote gender equality in science, since popular discourses of science as ‘for men’ seem less significant in their perceptions of science. However, Gigi’s recognition of both ‘gender equal’ and ‘gender stereotyped’ discourses of science did not appear to have widened her views of science careers. Although Gigi had science-related careers aspirations (to be an archaeologist as a second choice), she implied that being a scientist, or using science in the future, was almost unthinkable because ‘when I see myself as a scientist I see myself with white hair’ and she ‘don’t really know any jobs other than a scientist that uses science’. Thus, Gigi appears to command a narrow view of careers in or from science, and her perceptions of scientists as people with ‘white hair’ aligns with popular media constructions of scientists as old(er) people (Türkmen, 2008). As such, Gigi did ‘enjoy science but I don’t think it’s really that exciting’, which resonates with the young people in the study by Archer *et al.* (2010b) who said that they like doing science, but did not want to ‘be’ a scientist. Thus, students who share egalitarian discourses of science do not necessarily aspire to science-related careers, nor foresee the use of science in their future careers, as science may be seen to be interesting but ‘not for me’ (Jenkins and Nelson, 2005; Losh, 2010).

When students were asked for their views about the general lack of women in science at higher levels, many – including those who expressed egalitarian views of science as ‘for anyone’ – made reference to the ‘natural’ differences in science interest between girls and boys, which seemed to reflect traditional gender stereotypical discourses (*see* earlier). For instance, Jenny (13, F, Indian, Cranberry) expressed ‘gender equal’ views of science (‘if there is a guy and a woman, and they both did the same thing, and they both want to become a scientist, like, they can’) but she also recognised that ‘men are more interested into it [science] whereas women might want to be something more like stuff men don’t do, like cook and stuff and things like that’. In this case, there appears to be a tension within the discourses of students such as Jenny between, on the one hand, the expression of idealistic, egalitarian values in relation to their perceptions of science and on the other, their awareness that a ‘science identity’ (and the embodied image of the scientist) continues to be popularly associated with men.

Similarly, Mani (12, F, Pakistani, Barton) articulated an egalitarian discourse of science as ‘for anyone’ and criticised the view that men dominated science as ‘sexist’. However, Mani later claimed that ‘men have more brains than girls’ and implied that girls cannot be scientists because girls are ‘stupid’. In this case, Mani appeared to utilise apparently conflicting discourses of science simultaneously (e.g. as ‘for anyone’ but also ‘for men’). On one level, egalitarian discourses (of science) would reflect wider educational policies that promote ‘equal opportunity’, as students internalise the view that ‘anyone can be anything’ (e.g. JJ, *see* earlier). However, such ideologies can also (temporarily or permanently) mask structural and social constraints, such as gender inequality. Borrowing the distinctions between abstract and concrete attitudes in Mickelson’s (1990) ‘attitude-attainment paradox’ (*see* Chapters 1, 4 and 5), egalitarian discourses of science may only provide students with an ‘abstract’ view of science, constructed through what students think the science field *should* be (i.e. ‘for anyone’). Their ‘concrete’ views of science, however, will be formed through their embodied experiences in science, which existing literature have found to be challenging or difficult amongst women and minority ethnic groups (e.g. Marlone and Barabino, 2009; Ong, 2005). For students such as Mani, the discourse of science as ‘for anyone’ may operate at one level but it exists in parallel with gendered discourses of science as ‘for men’. However, it seems that some students were able to hold and express contradictory discourses, which suggests that students’ views of science can be multiple, shifting and, as in the case of Mani, inconsistent.

In this case, the promotion of gender equality in science may require more than the presentation of ‘successful’ women in science, since women, in this view, represent an exception rather than the norm. As students such as Jenny and Mani appear to have complex, and sometimes inconsistent, gendered perceptions of science and scientists, it may be worthwhile for science initiatives (e.g. TWIST – Towards Women in Science and Technology – project, Heather King, personal communication, August 29th, 2011) to deconstruct traditional gender discourses so that students’ perception of science and science careers are not bounded by stereotypes of gender (Francis and Skelton, 2005, *see* Chapter 9).

Across the student interview dataset, most students (12 out of 17) who expressed *only* ‘gender equal’ views of science held science-related career aspirations (4 out of 7 girls, 8 out of 10 boys). In comparison, just over half the students (15 out of 29) who utilised gender discourses of science as ‘for men’ held science-related career aspirations (7 out of 13 girls, 8 out of 16 boys). A similar proportion of boys and girls expressed views of science as ‘gender equal’ or ‘gender stereotyped’, even though boys with ‘gender equal’ views of science were slightly more likely than their girl counterparts to express aspirations in science-related careers. Although such differences were numerically small, girls with ‘gender equal’ views of science may also be influenced by wider inequalities and expectations of gender, especially with the science field popularly perceived/constructed as masculine (Ceci and Williams, 2007) and ‘not for me’ (Jenkins and Nelson, 2005).

It is interesting to note that although a minority of Chinese students (4 out of 13) stated science-related career aspirations (*see* Chapter 4), the majority (8 out of 13) expressed *only* ‘gender equal’ views of science. As such, Chinese students with *only* ‘gender equal’ views of science did not necessarily aspire toward science careers, even though many continued to achieve highly in science and were categorised in the ‘higher’ ends of the ‘student science engagement’ typology (e.g. *engagement without aspiration*, *see* Chapter 4). Indeed, in relation to the ‘student science engagement’ typology, students categorised with *medium engagement* (4 out of 6), *engagement without aspiration* (4 out of 10) or *interest* (2 out of 3), and *high engagement* (5 out of 10) were more likely to express *only* ‘gender equal’ discourses of science than students categorised with *low* (1 out of 9), *wishful* (1 out of 6) and *ideological engagements* (zero out of 2) with science. Although such a distinction may have limited implications – since the typology was based on the tentative markers of ‘science achievement’, ‘science aspiration’, ‘science interest’ and ‘science capital’ (*see* Chapter 4) – it seems that students categorised in the ‘lower’ ends of the ‘student science engagement’ typology (e.g. *low engagement*) were more likely to construct science through the lens of ‘gender stereotyped’ than students categorised in the ‘higher’ ends (e.g. *high engagement*). Likewise, students categorised in the ‘higher’ ends of the ‘student science engagement’ typology were more likely to express *only* ‘gender equal’ views of science.

In general, students who viewed science as *only* ‘gender equal’ appeared more likely to command science career aspirations than students who saw science as dominated by men. In this case, a ‘science identity’ may be more accessible for students who draw upon egalitarian discourses of science, such as ‘gender equal’ views of science, as these students may come to believe that ‘anyone can be anything’.

Science and ethnicity: A field ‘for white people’?

In this section, students’ perceptions of science are explored through the discourses of science as dominated by people who are racially/ethnically white or as ‘for anyone’. The majority of students (28 out of 46) in this study expressed views of science as ‘racially stereotyped’ through the discourse of science as ‘for white people’, and under half the students (18 out of 46) articulated *only* ‘racially equal’ views of science, through egalitarian discourses of science as ‘for anyone’. As in the previous section, the ways in which minority ethnic students constructed and associated with science are explored through their perceptions of science as ‘racially stereotyped’ and/or as ‘racially equal’.

A similar proportion of students across gender, class and ethnic backgrounds (except Pakistani) expressed views of science as ‘racially stereotyped’, drawing on the racialised discourses of science as ‘for white people’. There were insufficient data to explain the tendency of Pakistani pupils (4 out of 5) to utilise *only* ‘racially equal’ discourses of science, which may be due to the small number of Pakistani participants. There were also minimal differences amongst students categorised in the seven types of ‘student science engagement’ (*see* Chapter 4) in relation to students’ views of science as ‘racially stereotyped’ or ‘racially equal’.

In his description of a scientist, Tim (13, M, Bangladeshi, Everest) envisioned ‘an old man, he’s white, I’m not being racist, he has white hair, he has white lab jacket, posh and clever, not really posh, well-educated, and he wear glasses’. Such a perception of a scientist as male *and* white seems to be facilitated through the media, as students come to recognise the image of scientists to be ‘white men’ (Chimba and Kitinger, 2010). For example, Ramos (12, M, Indian, Cranberry) appeared confused that ‘even on TV programmes and cartoon, they’re mostly only show white people as

scientists and I don't know why'. Likewise, Tracey (12, F, Chinese, Lancang) stressed that 'the books I read, it's all western [white] scientists' and Saiyef (14, M, Bangladeshi, Everest) claimed that 'most well-known and successful scientists have a European [white] background, you know, such as Einstein'. Students' reference to Einstein as the epitome of science was supported in previous literature (e.g. Archer *et al.*, 2010b; Koren and Bar, 2009) as the media seem to (re)produce the typical scientists through characteristics popularly associated with Einstein, such as white (old) men with 'wild' hairstyles (Chimba and Kitzinger, 2010; Epstein *et al.*, 2010; Mendick *et al.*, 2008).

According to Marlone and Barabino (2009), who explored the challenges of two African American women in STEM graduate settings, minority ethnic students in science education were often subjected to experiences of 'isolation, marginalisation and invisibility'. Marlone and Barabino argued that minority ethnic students were often the 'only one' of their 'race'/ethnicity in their science community, and their racial/ethnic identities represent 'an additional burden' that could undermine their sense of 'being valued' in their community of science. Thus, for minority ethnic students, particularly girls, identifying with science, or being seen as a 'science person', may not have been perceived as being 'naturally' congruent with their gender and/or ethnic identities due to the dominant identity discourse of scientists, as 'white men' (Baker, 1998). A small number of participants recognised the potential barriers of racism and 'being racially judged' in white-dominated fields such as science. For example, Vincy speculated that as:

Most of the scientists are like white, and there's not many black, so, erm, black people might get like dis-encouraged, like not very encouraged, and they will think 'oh what if they make fun of us or something?' then it's mostly white people who are scientist, don't know why. (Vincy, 14, F, Indian, Cranberry)

According to Vincy, the dominance of white scientists can position other groups, such as 'black people', as isolated members in the science field who may be unreasonably marginalised and scrutinised ('not many black ... what if they make fun of us or something?'). As discussed further in Chapter 8, recognition by others

(such as science teachers) of the minority ethnic individual as a ‘science person’ could be ‘racially stereotyped’ and challenged (Carlone and Johnson, 2007; Marlone and Barabino, 2009).

Some students, however, also admitted that careers in science, or being a scientist, were rare for ‘people like me’ as non-science-related professions, or careers related to (but not *in*) science (such as the medical field), were more typical and desirable choices (e.g. *see* ASPIRES – Science Aspirations and Career Choice: Age 10–14 – project, Jennifer DeWitt, personal communication, September 19th, 2011). For example, Amy (12, F, Pakistani, Barton) claimed that ‘most Asians want to be doctors ... or accountants ... not scientists’ and Hins (13, M, Chinese, Yangtze) believed that Chinese people are ‘more interested in business, there’s more, the money side, economics and just, yeah, more that area than science’ (*see* Chapter 5). According to Amy and Hins, being a scientist is not valued by ‘Asian’ or ‘Chinese people’ as much as having a career in business or medicine (e.g. as a doctor). In this case, career aspirations in science, or being a scientist, would seem undesirable (or even ‘unthinkable’, *see* Chapter 6; Archer *et al.*, 2010b) for some students, even though science-related careers remain popular within minority ethnic students’ career aspirations (*see* Chapter 4). Such an irony may suggest that careers *in* science, which appears to be understood by students in the study as being a scientist, remain exclusive to the archetypical ‘white middle class men’ (Baker, 1998), as minority ethnic students continue to perceive science, or rather the profession of scientist, as something ‘not for me’ (Jenkins and Nelson, 2005). In this case, a ‘science identity’ constructed through the discourses of science as ‘for men’ and ‘for white people’ could mean girls and minority ethnic students may need to challenge the popular perceptions of science (e.g. as for ‘white men’) if they are to personally identify with science (e.g. Ong, 2005).

However, the popular portrayal of science and scientists as ‘white men’ was challenged by some participants (18 out of 46) who claimed that science was accessible to everyone from any ethnic backgrounds. Informed through egalitarian discourses of science as ‘for anyone’, JJ (12, M, Black Caribbean, Barton) asserted that ‘anyone could be a scientist if you’re Asian, Caribbean, English, like, Scottish, all, every country, anyone can be a scientist, not just a particular race’. Likewise,

Slifer (11, M, Indian, Barton) questioned the popular discourse of scientists as ‘for white people’ by suggesting that ‘there could be scientists who can be, like, black, Asian or Chinese or whatever; they don’t have to be white’. Students such as JJ and Slifer believed that racial/ethnic backgrounds are irrelevant as to whether one becomes a scientist or not, because ‘anyone can be a scientist’. In this case, the discourse of science as ‘for anyone’ may alleviate the concerns of ‘race’/ethnicity as ‘an additional burden’ (Marlone and Barabino, 2009) in some minority ethnic students’ identifications with science, given ‘race’/ethnicity was not considered by these students as a barrier in their associations with science.

Similar to Gigi and Mani in the previous section, some students seem to draw on both ‘racially equal’ and ‘racially stereotyped’ views of science. For example, Ronnie (14, M, Bangladeshi, Everest) claimed he had seen ‘black scientists, I have *seen*, like, Asian scientists, Chinese scientists, I’ve seen that everyone can become scientists’. Such views are interesting because Ronnie said he had ‘seen’ scientists from minority ethnic backgrounds, while many other students – including some who expressed *only* ‘racially equal’ views of science – have tended to say they have ‘never’ seen scientists similar to their own (or other minority) ethnic backgrounds (e.g. ‘I’ve never seen a Pakistani, Bangladeshi or Indian scientists’, Kyle; ‘I don’t really see black scientists to be honest’, Gina; ‘I haven’t really seen any Chinese scientists’, Holly). However, Ronnie did not specify where, or in what context, he had ‘seen’ scientists from various ethnic backgrounds, which could have been tokenistic representations of scientists in the media (Chimba and Kitzinger, 2010). Indeed, Ronnie also drew on racialised discourses of science as ‘for white people’ in his interview:

INT: Now, some people say that there are not too many Asian scientists...what do you think?

RONNIE: I’m not sure, it’s kinda true; I’ve not seen many Asian scientists.

INT: Why not?

RONNIE: I’m not sure.

INT: What do you see when you see a scientist? If they’re not Asian, where are they from?

RONNIE: I’d say from here.

INT: Here?

RONNIE: Yeah, like [white] English people.

In a similar vein to Mani (*see* previous section), Ronnie appeared to have drawn on discourses of science in relation to ethnicity that seemed contradictory (e.g. as ‘for anyone’ but also ‘for white people’). On the one hand, he proclaimed to ‘have seen like black ... Asian ... Chinese scientists’. However, when Ronnie was asked about his views towards the lack of Asian scientists, he drew on racialised discourses of science as ‘for white people’ (‘I’d say from here ... like [white] English people’). Although Ronnie may have ‘seen’ minority ethnic scientists, his views of science were also shaped through racialised discourses, which could reflect structural inequalities within wider society or even within school science (Shanahan and Nieswandt, 2011). In this case, students such as Ronnie may draw on ‘racially stereotyped’ views of science even though he claimed to have ‘seen’ scientists from minority ethnic backgrounds.

Such findings highlight the potential difficulties in promoting science to young minority ethnic students as a ‘racially equal’ field, because students’ science views could simultaneously be shaped by popular (e.g. media, *see* earlier) discourses of science as ‘for white people’. However, Ronnie’s conflicting views of science as ‘racially stereotyped’ and ‘racially equal’ did not appear to have deterred his aspirations towards a science-related career, which was to be an engineer (e.g. *see* ‘Social capital’ in Chapter 5).

In general, students’ views of science as ‘racially equal’ or ‘racially stereotyped’ appeared unrelated to their aspirations towards science-related careers. Although such findings may provide some comfort to stakeholders who promote science equity, since students in this study expressed aspirations towards science careers even if they recognised popular images of science as ‘for white people’ (and ‘white men’ in particular), the main challenge would be to address the apparent gap between minority ethnic students’ science aspirations at ages 11-14 (*see* Chapter 4) and their general underrepresentation in post-compulsory science (Elias *et al.*, 2006, *see* Chapter 1). Furthermore, although two-thirds of students (12 out of 18) who expressed egalitarian views of science as ‘racially equal’ expressed science-related

career aspirations, just over half of the students (15 out of 28) who utilised racialised discourses of science as ‘for white people’ reported aspirations in science-related careers. In this case, as in the previous section, students who *only* drew on egalitarian discourses of science seemed slightly more likely to have science career aspirations than students with ‘racially stereotyped’ views of science. A ‘science identity’ may therefore be harder to sustain in the long-term (e.g. more challenging to have self-recognition in science) and less appealing amongst minority ethnic students who share the view of science through the discourse of science as ‘for white people’.

Science and class: As ‘oriented towards the middle class’?

Previous studies on social class and science have suggested that ‘middle class’ students were more likely to have aspirations towards science-related careers and education than their ‘working class’ counterparts (e.g. Adamuti-Trache and Andres, 2008; Gorard and See, 2009; *see* Chapter 1). In Chapter 4, the influence of social class on minority ethnic students’ science-related career aspirations was found to be insignificant. Yet, previous studies have rarely explored the views of students, particularly minority ethnic students, and their views of science as a ‘middle class’ domain. If popular discourses of science position ‘white middle class men’ as dominant figures in science (Baker, 1998; Burnell, 2009), then the discourse of science as ‘oriented towards the middle class’ merits further investigation, as in the case of gender and ethnicity (*see* earlier sections). In this section, the discourses of science as utilised by students in relation to class: as ‘oriented towards the middle class’ and as ‘for anyone’, are discussed. Unlike the previous two sections, the majority of students (29 out of 46) in the study seemed to have rejected the view that the ‘middle classes’ (or people with ‘more wealth’, to be precise) dominate the science field, with a minority of students (17 out of 46) who expressed views of science that can be understood as being ‘oriented towards the middle class’.

In contrast to Bourdieu’s conceptualisation of class (*see* Chapters 2 and 5), the notion of social class was mainly interpreted by students in the study in the context of financial wealth and how (dis)advantages of economic power (or the lack of) could shape science aspirations, achievement and/or engagement. The ‘middle

classes' were generally constructed as 'economically rich' and the 'working classes' as 'economically poor'.

When asked about his views on the assumption that 'rich' people tend to dominate those in the science field, Dee (13, M, Chinese, Yangtze) utilised the discourse of science as 'oriented towards the middle class' and agreed that 'rich people do have a bit of a boost because ... if they are stuck on science and all that stuff they get tutors, which make it easier for them to learn'. For Dee, students from 'middle class' backgrounds could receive more support in their learning of science through the purchase of tuition (Smyth, 2009; *see* Chapter 5). Similarly, Vincy explicated that:

The rich people can afford, like, the Bunsen burners and a whole lab [at home], but poorer people, they can't afford, like, sometimes they can't afford revision books, let alone, like, the beakers and stuff, so, yeah, so they might not have the chance. (Vincy, 14, F, Indian, Cranberry)

The orientation of science as a 'middle class' domain seemed to be formulated by Dee and Vincy through people's financial ability to purchase science resources, such as 'a whole lab', science textbooks and tuitions. For students such as Dee and Vincy, a 'science identity' may be more open to 'middle class' students who get 'a bit of a boost' in science. More generally, Tony (14, M, Black Caribbean, Everest) drew on classed discourses and simply suggested that 'rich people, they have, like better options, their parents can set up easy for them to get that interview, to make them smart'. In line with previous studies (e.g. Ball *et al.*, 2002a), Tony believed that students from higher socioeconomic backgrounds were well supported by their parents, who could open up 'better options' for their children's future employments. However, the views of Dee, Vincy and Tony seemed to assume only the 'middle class', or 'rich' people, could afford (or possess) science or economic capital.

As was mentioned in Chapters 5 and 6, some families – regardless of their socioeconomic background – can make financial investments in the (science) education of their children (*see also* Archer and Francis, 2007). In this case, it may be insufficient to analyse students' socioeconomic status and their views of science without the consideration of students' family cultural backgrounds, which could

complicate the discourses of science available to and drawn upon by students. Indeed, recent studies by Archer (2010, 2011) found the class advantage normally associated with the (white) ‘middle classes’ were complicated by racial inequalities in the context of British minority ethnic ‘middle classes’. Thus, the influence of social class can be mediated by ethnicity.

Indeed, the majority of students (29 out of 46) in this study seem to have played down the influence of money in shaping students’ science interest, achievement or aspirations. These students have utilised egalitarian discourses of science as ‘for anyone’ and have emphasised the importance of individual aptitude. As Ramos elaborated:

I also think that people like, from this school, can still be able to get to a, to become a scientist, only if they try hard, even if a rich person sent their son or daughter to a school, and pays a lot of money, but they’re not bothered, then they ain’t able to become one. (Ramos, 12, M, Indian, Cranberry)

Drawing on meritocratic values, Ramos believed in the importance of a work ethic (‘try hard’) ‘to become a scientist’ and talked down the role of finance in generating success in science, because success cannot be achieved by students who were ‘not bothered’, even if their parents ‘pays a lot of money’. The views of success in science through the lens of individual merit were shared by many other students. For example, Anita (13, F, Chinese, Everest) stated that ‘everyone is equal [in] doing science, everyone equal, poor or rich, if you know science, that’s it, that’s all’ and Amir (14, M, Bangladeshi, Everest) explained that ‘if poor people and they are really good at science then they still have a chance’. Likewise, Samantha (13, F, Indian, Cranberry) acknowledged that ‘the people who don’t have that much money, it’s harder for them [to do well in science], but they can still like achieve it, if they try hard and they’re dedicated to whatever they do’. Although Samantha recognised the difficulties for students with few financial resources to achieve in science, she utilised meritocratic discourses and insisted that people ‘can still like achieve it’ through hard work and dedication (Archer *et al.*, 2010b). For students such as Amy and Becky (*see below*), their egalitarian views of science as ‘for anyone’ may have been supported by their social capital (*see Chapter 5*), as they drew on their

knowledge of someone they know who succeeded in the science field despite coming from ‘poor’ backgrounds:

My uncle knows this guy, he was quite poor, from Pakistan, and when he came here, he had nothing, and now he is apparently a really wealthy doctor ... he was from the slums of Pakistan, and [now] he got everything, like, degree, and everything’. (Amy, 13, F, Pakistani, Barton)

Most of my families, one of them is a GP, and one of them is a pharmacist, and erm, they came from poor background, and I think if you really try [you can succeed]. (Becky, 14, F, Indian, Cranberry)

However, it should be noted that a number of students who suggested that success in science can be achieved through individual effort or brilliance also seemed to recognise the advantages of financial wealth in the purchase of science-related materials. For example, Denise commented that:

Rich people can actually join things like classes and stuff, so that they get someone [tutor]... but for poor people, if they’re really good at it maybe they can [do well in science]. (Denise, 11, F, Indian, Cranberry)

For students such as Denise, although ‘rich people’ can afford additional science resources, success in science was formulated through egalitarian discourses of science as ‘for anyone’, or more specifically, for those who were ‘really good at it’. The notion of science as for those who are ‘really good at it’ is explored further in the next chapter through the discourse of science as ‘for clever people’. As can be seen, minority ethnic students seemed to acknowledge but also played down the dis/advantages of class in science education and aspirations (Archer *et al.*, 2010b). Yet, although many (20 out of 29) students who drew on egalitarian discourses of science in relation to class expressed science-related career aspirations, only a small minority (7 out of 17) who expressed ‘classed stereotyped’ views of science (i.e. as ‘oriented towards the middle class’) aspired to science-related careers. Once again, students in the study appeared more likely to hold science-related career aspirations if they expressed egalitarian views of science.

Furthermore, there were no obvious patterns within and across the ‘student science engagement’ typology and students’ gender, class and ethnic backgrounds as the majority of students from each subgroups utilised egalitarian discourses of science as ‘for anyone’ in relation to the influence of social class. However, although many students claimed class to be irrelevant in science-related career aspirations, the findings from Chapters 4 and 5 appeared to suggest otherwise. There may be a pattern of class inequality as students from ‘middle class’ backgrounds were proportionally more likely to possess ‘high’ science capital than students from ‘working class’ backgrounds (*see* Chapter 4, Table 4.6), and students categorised with ‘high’ science capital were more likely to express aspirations towards science-related careers than students categorised with ‘medium’ or ‘low’ science capital (*see* Chapter 4, Table 4.8). Similarly, Chapter 5 found ‘middle class’ students in the study were more likely to possess science social and cultural capital than their ‘working class’ counterparts, which suggest that inequalities of class may operate at a more subtle level and not always recognised or acknowledged by students (e.g. in relation to aspirations for science-related careers).

Although existing studies suggest that (mainly white) ‘working class’ students are more likely than their ‘middle class’ counterparts to self-exclude from higher education (e.g. Archer *et al.*, 2007b) and are less likely to have aspirations in professional careers (e.g. Schoon and Parsons, 2002), such as the science field (Adamuti-Trache and Andres, 2008), this section has argued that a ‘science identity’ may be more accessible for students who utilised egalitarian discourses of science as ‘for anyone’. As found in Chapters 4 and 5, however, class inequality (e.g. such as class differences in possession of science capital, *see* Tables 4.6 and 4.8) can also shape students’ aspirations towards, and identifications with, science. In this case, a ‘science identity’ may also be more accessible to ‘middle class’, rather than ‘working class’, students.

Summary

This chapter has explored the notion of ‘science identity’ through the discourses of gender, ethnicity and class as utilised by students in relation to science, which

included science as ‘for men’, ‘for white people’, ‘as oriented towards the middle class’ and ‘for anyone’. As the majority of students in the study drew on gendered and racialised discourses of science as ‘for men’ and as ‘for white people’, one might assume that a ‘science identity’ may be more sustainable for ‘white men’ (e.g. the ‘norm’) than for women and minority ethnic groups (e.g. the ‘Othered’, *see* Said, 1978), as suggested in the literature (e.g. Carlone and Johnson, 2007; Marlene and Barabino, 2009; Ong, 2005). In this case, identities and inequalities of gender and ethnicity may disadvantage minority ethnic students in their pursuits for viable ‘science identities’. However, the majority of students in the study seemed to have rejected the view of science as ‘oriented towards the middle class’, or dominated by ‘rich’ people. Many students utilised egalitarian discourses of science as ‘for anyone’ in relation to class, even though inequalities of class appeared to have contributed towards students’ available capital in, aspirations towards, and identifications with, science (*see* Chapters 4 and 5).

In general, students in this study who *only* utilised egalitarian discourses of science as ‘for anyone’ were more likely to express science-related career aspirations than students who drew on discourses of science which acknowledged social inequalities. While two-thirds of students who *only* expressed ‘gender equal’, ‘racially equal’ and/or ‘class equal’ views of science held science career aspirations, only half of the students with ‘gender stereotyped’, ‘racially stereotyped’ and/or ‘class stereotyped’ science views expressed science-related career aspirations. Such findings seem to demonstrate a need for science initiatives to broaden/challenge stereotypical views of science (e.g. as typically ‘white middle class men’) and promote gender, racial and/or class equality in relation to students’ perception of science-related careers. Indeed, there also seems to be a knock-on advantage in that equality discourses appear to correlate with science-related aspirations, since students’ who expressed science career aspirations were more likely to express views of science through egalitarian discourses. Chapter 8 further explores the notion of ‘science identity’ through students’ construction of science as ‘for clever people’ and the ways in which minority ethnic groups are typically recognised (or not) by science teachers as scientifically competent.

Chapter 8 – ‘Being clever’ or being a ‘science person’: Evaluating the notion of ‘science identity’

Introduction

The influences of gender, ethnicity and class in relation to students’ identifications with science were explored in Chapter 7. This chapter now examines students’ identifications with science through Carlone and Johnson’s (2007) model of ‘science identity’, which states that a sustainable science identity requires both self-recognition and recognition by others as competent in science (*see* Chapter 2). The first part of this chapter examines the extent to which some minority ethnic students come to recognise themselves as proficient in science, through popular constructions of science and scientists as ‘for clever people’. These students appear to engage and participate in science as a means to perform ‘clever identity’, which they perceived to be available through the study of, and achievement within, science, even though many students seem to have conflated the notion of ‘cleverness’ with males and masculinity. Part two then explores the extent to which the second aspect of Carlone and Johnson’s theorisation (recognition by others of the student as competent in science) influences students’ science aspirations and engagement, by drawing upon science teachers’ views of minority ethnic students. It is argued that these seem to reproduce popular racialised discourses of minority ethnic students as reported in existing literature (*see* Chapter 2). The viability of Carlone and Johnson’s notion of ‘science identity’ for minority ethnic students is discussed in the final part of the chapter and it is suggested that student engagement or aspirations in science do not necessarily entail student identification with science. It is argued that the current conceptualisation of ‘science identity’ by Carlone and Johnson does not fully capture and explicate the range of identifications students appear to have with science. It is suggested that, in addition to the basic elements of ‘recognition by self and by others as competent in science’, the notion of ‘science identity’ could also usefully incorporate the markers of science interest, science aspirations and science engagement.

Constructing science as ‘for clever people’

As discussed in Chapter 7, some students rejected claims of gender, ethnic and/or class inequalities in relation to science participation because every individual was considered to have an equal chance of success in science education or careers. These students drew on egalitarian discourses of science as ‘for anyone’, which can also be read as meritocratic discourses, where success (in science) is possible and achievable through individual effort and/or ability, since everyone is presumed to have an equal opportunity to succeed. Although some students utilised egalitarian discourses of science (*see* Chapter 7), an overwhelming majority of students in this study also drew on the discourse of science as ‘for clever people’ in their perceptions of scientists, or people who worked in the science field. However, it is suggested that students’ perceptions of ‘clever people’ may be gendered, as some students appear to conflate men with being ‘naturally’ clever(er). In this case, students’ gendered constructions of science/scientists can be complex and contradictory, especially since some students have expressed views of science as both ‘for anyone’ *and* ‘for clever people’ – and constructed ‘clever people’ as predominantly men. The discourse of science articulated by minority ethnic students as ‘for clever people’ is explored in this section in relation to students’ identifications with science.

When students were asked ‘what type of people study science, or become a scientist?’ almost everyone made reference to the notion of ‘cleverness’ or intelligence (DeWitt *et al.*, under review; Shanahan and Nieswandt, 2011). Gigi (11, F, Chinese, Yangtze) explained that ‘if you’re not that clever, then you can’t really be like really good at science and stuff’ and Norman (12, F, Pakistani, Barton) reasoned that ‘I think to do science you have to be really clever’. Similar findings were echoed by DeWitt *et al.* (under review), who found that 81% of young people (aged 10-11) in their national survey of 9,319 pupils in England ‘strongly agreed’ or ‘agreed’ that scientists, or people who worked in science, were ‘brainy’. Existing literature also found science to be perceived by students as ‘hard’ (Osborne *et al.*, 2003), and that to be ‘really good at science’ required ‘natural brilliance’ (Archer *et al.*, 2010b). In this case, most students appeared to construct people in the science

field as ‘naturally clever’, and implied that scientists and people who study science were different from ‘normal’ and particularly less ‘clever’ people.

Indeed, the notion of cleverness appears to be gendered within educational discourses (Renold, 2001; Renold and Allan, 2006). Skelton *et al.* (2006: 145) argued that “teachers continue to see girls as succeeding through their quiet diligence and hard work, while boys are more ‘naturally clever’”. For example, Carlone (2004) reported that science teachers often make a distinction between students who ‘work hard’ from those who were ‘naturally smart’, assuming that some students, typically girls, require time to understand science concepts while others, typically boys, tend to just ‘get it’. Such views, according to Carlone, were also shared by students themselves. In the context of physics, Carlone found that girls tend to stereotype those who excel in science as ‘smart’ boys who were ‘naturally brilliant’. These girls may have drawn on gendered discourses of science as ‘for clever men’, where boys typically possess the ‘raw talent’ necessary to succeed in science (*see also* Mendick, 2005a in the context of mathematics). While many students in the current study have expressed egalitarian views of science as ‘for anyone’ (*see* Chapter 7), an egalitarian view of science as ‘for clever people’ can appear dubious since the discourse of science as ‘for clever people’ may be subjected to social inequalities, such as gender. As discussed below, some students, including those who have expressed ‘gender equal’ views of science, have (explicitly or inexplicitly) constructed boys as the norm and girls as the other in science through the notion of ‘cleverness’ (Carlone, 2004; Ceci and Williams, 2007).

For instance, Fay (13, F, Bangladeshi, Barton) made an implicit association between male dominance in science and ‘cleverness’ by implying that ‘most science teachers are men as well’ while claiming ‘intelligent people’ as ‘people who are good at science’. Fay appeared to construct science as a field for ‘clever men’, while ‘normal’ girls, like her, were more interested in hetero-feminine identities (Francis, 2000a, 2000b; Jones and Myhill, 2004; Whitehead, 1996). Such views, however, may merely reflect the fact that there was only one female science teacher in her school (Ms Smith in Barton). The conflation of ‘cleverness’ with males and masculinity was also shared by Mani (12, F, Pakistani, Barton) and Becky (13, F, Indian, Cranberry), who speculated that boys have ‘more’ or ‘better’ brains than girls

and thus, the dominance of men in science may simply reflect the ‘natural intelligence’ of men over women (Halpern *et al.*, 2007). Indeed, Harry (14, M, Chinese, Everest) explained that the dominance of male scientists was due to men being ‘quite clever’ with ‘good imagination’, while girls ‘don’t imagine’ as much as men, and are ‘not as brainy’ or ‘fun as men’. For Harry, the science professions were formulated through masculinised values such as intelligence, creativity and humour (Brickhouse, 2001). In this case, a ‘science identity’ seems inextricably linked with masculinity and/or cleverness, and appears to contradict egalitarian views of science because students seem to perceive ‘clever people’ as particular/specific individuals (e.g. boys/men) and not just anyone.

While it could be argued that cleverness could have positive or negative connotations, it was notable that a small number of students, mostly from Indian and Pakistani backgrounds (with and without science-related career aspirations), utilised a socially stigmatised aspect of the notion of cleverness/intelligence, such as being ‘geeky’, within their perceptions of people in the science field. In a focus discussion group with Pakistani students, Mani (12, F, Pakistani, Barton) noted ‘the people that are geeky, who tuck in their shirt and ties’ were the people who study science. She explained that ‘clever is just like, *not* geeky people’ because ‘geeky [people] put your hand up to answer questions! Every question put your hand up; you need to know the answer’. Mani appeared to construct geekiness as people who were not just clever, but also overtly oriented towards education and ‘answer’, perhaps to a point of obsession. Similarly, Norman suggested that ‘its geeky people that do science’ and explained that ‘geeky people are, like, teacher’s pet, like, know everything’ while ‘clever people, like, they do like science and maths, and get good jobs and qualifications’. For students such as Mani and Norman, it was mainly ‘geeky people that do science’, as they ‘know everything’ and ‘answer ... every question’, even though ‘clever people ... do like science ... and get good jobs and qualifications’.

Although the meaning of ‘geeky’ may vary amongst students, Mani and Norman’s understanding of ‘geeky’ seems to align with the notion of the ‘swot’ as described by Francis (2009: 651), that is, “a pupil who was not just highly academic and diligent, but also obsequious and oriented towards the teacher rather than peers”. While the notion of ‘geeky’ (or ‘geek’) has been studied more extensively in the context of

computing science (e.g. Eglash, 2002; Grant *et al.*, 2007; Varma, 2007), some characteristics of ‘geeky people’ have often been associated with scientists within the science education literature. For example, scientists tend to be portrayed in the media as ‘socially inept’ (Long and Steinke, 1996) and geeks were generally considered to be ‘socially awkward’ (Francis, 2009; Kendall, 2000; Mendick and Moreau, 2010). Personality traits such as ‘arrogant’ (Türkmen, 2008), ‘dangerous’ (Haynes, 2003), ‘eccentric’ (Losh *et al.*, 2008) and ‘obsessive’ (Kirby, 2003) were also popularly associated with scientists. Indeed, some studies suggest that taking on the identity of a ‘geeky’ scientist is often considered by students as ‘unsuitable’ for a woman and/or a popular boy (Flicker, 2003; Kitzinger *et al.*, 2008), because ‘geeky’ (or ‘nerdy’) identities tend to reflect specific forms of masculinity (Mendick, 2005b). In this case, one might ask how the identity of ‘cleverness’ (and its ‘flipside’ of being ‘geeky’) may shape minority ethnic students’ identification with science?

It is now argued that ‘cleverness’, which students often associate with science, can play an influential role in their identifications and/or engagement with science. Drawing on the notion of identity as performative (Butler, 1999, *see* Chapter 2), it is argued that some students’ aspirations to study science could reflect their desire to perform cleverness, as achievement in science can serve as a symbolic marker for ‘clever students’. The example of Samantha, a 13-year-old Indian girl from Cranberry, is now presented to illustrate how a desire to perform/inhabit cleverness can motivate/drive some students’ engagement with science.

Samantha was categorised as having *engagement without interest* in science (*see* Chapter 4) because she was able to perform academically (e.g. being a ‘top set’ and ‘high’ achiever in science, *see* Chapter 4) despite her declining interest in science (‘I used to really like science, like in primary school ... I don’t know, I’m not really interested in it anymore ... I find it really boring and I just don’t really want to listen’). Interestingly, for her GCSE subject choices, Samantha aspired to study ‘triple science’ – the most comprehensive form of science available at GCSE level – as she (and a small cluster of her close friends who were also interviewed, e.g. Becky, Jenny, Vincy and Joyce) regarded it as ‘better’, ‘smarter’ and ‘cooler’. For example, one of her close friends, Becky (14, F, Indian, Cranberry), reasoned that ‘I’m doing triple science; ‘cos I want to be smart ... there’s just something about it

that, you know, smart'. In line with previous research (e.g. Carlone, 2004; Shanahan and Nieswandt, 2011), Samantha constructed those who were interested in or who studied science as 'people who are smart enough to be scientists', which implied cleverness as a prerequisite for the study of (advance) science. While Samantha had aspirations to be a doctor, her preference was to be a lawyer, as she possessed *higher quality* social capital in the field of law. As mentioned in Chapter 5, Samantha's 'law social capital' came from her uncle and aunt, who were both lawyers. Samantha's 'medical social capital' came from her peers, who shared similar aspirations (i.e. *lower quality* social capital, *see* Chapter 5). Although Samantha expressed 'gender stereotyped' views of science/scientists (*see* 'Science and gender: A masculine field?' in Chapter 7), she still aspired to study science at the highest level (i.e. triple science GCSE) because Samantha appeared to draw on the discourse of science as 'for clever people', which also supports the view of science as 'high status' (Archer *et al.*, 2010b).

Samantha described the prestige of triple science for future educational and careers options ('it can help me in the future and stuff, like good to do that. It's a good qualification'), which could shed light on her cultural capital concerning the hierarchy of subject status (Francis, 2000b). Similar findings were also reported by Brickhouse and Potter (2001) in the context of African American urban schoolgirls, where 'Ruby', one of two girls in the study, admits to having little interest in computers, but yet appears to value her study of computing because of extrinsic reasons, such as "the promise of a high salary when she entered the workforce" (p. 977) and for college application. Samantha's point was exemplified through her dismissal of art as a GCSE subject, claiming it to be 'a waste of GCSE'. Another friend, Vincy (14, F, Indian, Cranberry), also rejected art despite her interest in it because she did not consider art as a career ('I know art is something that I enjoy, but, like, that's not really important, that's not called a job'). Thus, the study of triple science appears to offer Samantha (and her close friends) a type of desirable student identity because it represents cleverness and academic status, which may reflect their family cultural discourses (*see* Chapter 6). In contrast to wider gender literature which found cleverness to be associated with males and masculinity (e.g. Renold, 2001; Renold and Allan, 2006), the identity of 'cleverness' seemed to be positively

constructed and actively pursued by Samantha (and her close friends) through the study of, and achievement within, science.

As well as her own identification with science, Samantha was also positioned by others as science-oriented. Samantha suggested that her school acquaintances often associate her with scientific interests. As Samantha recalled, ‘they probably think I want to be a scientist ... or something involved in that area, I don’t know why ... just expect me to be interested in that stuff’. These expectations may stem from Samantha (and her close group of friends) being regarded by large sections of their year group as ‘geeks’ and ‘nerds’. The notion of ‘nerds’, for Samantha, appeared to be understood in relation to high achievement and a hard working ethic (‘we’re kinda classified as nerds ... because we always do well in exams and stuff, and we try hard’). In this case, the positioning of Samantha (and her close friends) as ‘nerds’ (by her school acquaintances) may actually play in Samantha’s favour with regards to her identification with science. This was because her interpretation of ‘nerd’ identity seems to align with her desired performances of cleverness and being ‘high achieving’.

In negotiating the term ‘nerd’, Samantha empathised with being clever (‘not really geeky ... just clever’) while repositioning her antagonists – who were also regarded as the ‘popular’ girls – as ‘rude’ people. As such, Samantha and her close friends developed the strategy of ‘laugh it off’ by ‘thanking’ their antagonists for their ‘compliments’ (Nayak and Kehily, 2006). In return, Samantha and her close friends also negatively constructed (and pathologised) their antagonists as ‘immature’ (‘it makes me wonder ... how are they going to get it ... they don’t concentrate in class’) and overly ‘hetero-feminine’ (‘they play games that are really childish ... [like] truth or dare ... and dirty ... the girls always talk about boys’). For Samantha, a ‘clever’ and ‘high achieving’ identity (which ‘rude’ people would call ‘nerds’) appears to be defined against the characteristics of their antagonists (i.e. the ‘popular’ girls), who were constructed through ‘working class’ girl discourses as imprudent, excessively feminine and sexualised (e.g. Archer *et al.*, 2007b).

Interestingly, and in contrast to the findings of other studies which mainly looked into white students (e.g. Francis *et al.*, 2010), Samantha and her close friends

appeared to have made few attempts to ‘balance out’ their performances of ‘cleverness’ (and ‘high’ achieving) student identities with performances of hetero-femininity. Samantha (and her close friends) resembles ‘the survivors’ in Shain’s (2003) study, where ‘British Asian’ students conform to the (Asian) ‘good pupil’ stereotype of obedience, hard work and high achievement, and Renold’s (2001) ‘square-girls’, where high achieving primary schoolgirls rejected popular culture and hetero-feminine performances. For instance, classroom observations (and interview notes) of Samantha, Becky, Jenny and Vincy identified them as ‘quiet students with ‘simple’ appearances, who wore little if any make-up, nor had any decorative accessories or jewellery other than plain coloured headband or hair clips’. Thus, performances of ‘cleverness’ and hetero-femininity may be constructed by Samantha as two incompatible domains, or what Renold and Allan (2006) termed the ‘feminine-ization of success’. Indeed, Ong (2005) noted that some female physics undergraduates from minority ethnic backgrounds purposefully limit their hetero-femininity by wearing trousers and no make-up in order to appear as creditable and competent scientist-to-be. Likewise, a ‘clever’ identity may be undermined if engaged with hetero-feminine activities, as implied in Samantha’s construction and dismissal of popular girls as immature and only talking about boys. Although recent studies have discussed the maintenance of popularity amongst high achieving pupils (e.g. Francis *et al.*, 2010), the ‘incompatibility’ between these (apparently) polar opposites may still exist within Samantha’s construction/understanding of a ‘clever’ identity, which may also reflect the discourse of the ‘good student’ who works hard, behaves well and achieves academically. For Samantha, then, the study of science (or triple science to be precise) may be constructed as a practice which confirms (or reaffirms) the identity of being ‘clever’ and ‘high achieving’ (e.g. Brickhouse *et al.*, 2001). Drawing on the discourse of ‘being the best’ as discussed in Chapter 6, for Samantha, the identity of ‘cleverness’ and ‘high achieving’ may be something desired, expected and normative for ‘people like me’.

In this case, Samantha’s identification with science can be seen as a key part of her *performativity of intelligence* (Butler, 1999). For Samantha, it is not the actual science (and ‘scientific identity’) that she is keen to associate with, but her understanding of a ‘scientific identity’ as signalling/embodying a ‘clever’ identity. Consequently, it is argued that the study of science does not necessarily imply the

take up of a 'scientific identity' *per se*, as the study of triple science is constructed (by Samantha and her close friends at least) as a marker for cleverness (and 'high achieving'), where competence can be demonstrated and performed (i.e. science is not intrinsically valued). Furthermore, Samantha was able to negotiate an alternative space within the gendered identity discourse of 'good student' through her performances of 'cleverness' that were facilitated by her family cultural discourses (see Chapter 6). The popular discourse of 'British Asian' girls as 'high achieving' (Shain, 2003) may also suggest that racialised, as well as gendered, forms of 'good student' identity could complicate students' identification, performance and engagement with science and education (e.g. Archer and Francis, 2005, 2007). As such, some girls and minority ethnic students may be able to challenge gendered and/or racialised discourses of science as 'for men' and/or 'for white people' (see Chapter 7) through the discourse of science as 'for clever people'.

This section has explored the dimension of self-recognition within Carlone and Johnson's (2007) model of 'science identity', through the discourse of science as 'for clever people' which was expressed by the vast majority of students in the study. Although the notion of 'cleverness' has been conflated by some students with males and masculinity, and being a 'geek', other students seem attracted to the 'clever identity' they perceived to be available through the study of, and achievement within, science. For students such as Samantha, participation in science may be a form of their performance of 'cleverness'. Although Samantha has self-recognition as competent in science, she has little or no personal identification with the subject *per se* (e.g. she claimed to have no interest in science lessons). The case of Samantha is revisited later (see "'Science identity': Is it useful?") to discuss the usefulness of Carlone and Johnson's 'science identity model' for students like her. The dimension of recognition by others as competent in science within the 'science identity model' (Carlone and Johnson, 2007) is discussed in the next section through science teachers' views of minority ethnic students in their classes.

Science teacher perceptions of minority ethnic students

Teachers' perceptions and expectations as well as their engagement and interactions with students can significantly influence students' educational experiences (Carlone

et al., 2011; Osborne *et al.*, 2003; Tan and Calabrese Barton, 2010). For instance, teachers generally command significant authority and control in pupils' educational progress, such as making recommendations for ability-based classes (Gillborn, 2008). Previous studies (e.g. Archer and Francis, 2005, 2007; Crozier and Davies, 2008; Gillborn, 1990) have suggested that teachers tend to hold presumptive notions of the ability and behaviours of pupils based on particular racial/ethnic backgrounds. The poorer achievement of some minority ethnic groups (e.g. at GCSE, *see* DfE, 2010a) has been argued to be strongly effected by lower teacher expectations (Gillborn, 1990; Sewell, 1997; Strand, 2011b). For students in this study, recognition by others as being a 'science person' can depend heavily on science teachers, who tend to be the 'master practitioners' of school science (Lave and Wenger, 1991; Tan and Calabrese Barton, 2010). This section draws on data from science teacher interviews and explores their views and expectations of minority ethnic students. Although there were only five interviews with science teachers, they all expressed similar views toward British Chinese, 'British Asian' (understood as Indian, Pakistani and Bangladeshi) and Black Caribbean students and families. In line with existing literature (*see* Chapter 2), science teachers in this study viewed 'British Asian' (e.g. Indian, Pakistani and Bangladeshi) and Chinese students as typically hardworking and high achieving (Abbas, 2002a; Archer and Francis, 2005, 2007), while Black Caribbean students were typically racialised as disruptive and problematic (Gillborn, 1990; Mirza, 1992; Wright, 2010; Youdell, 2003). Thus, a 'science identity' in school may not be readily available or achievable for students who are conceived of negatively by science teachers (e.g. Black Caribbean). Such a proposition is supported by previous US studies which reported difficulties for women and minority ethnic students in their negotiation of science (or mathematic) identity in the classroom as a result of lower, and often gendered and racialised, expectations and perceptions from teachers (e.g. Brickhouse and Potter, 2001; Lim, 2008; Ong, 2005).

British Chinese students were typically seen by science teachers in the study as hard working, quiet, high achieving and relatively anonymous within the classroom (Archer and Francis, 2005, 2007). For example, Ms Smith (36, F, White Other, Barton) commented that 'it's almost impossible to get them put their hands up to ask questions' while Mr Tallman (37, M, White English, Barton) found British Chinese

students ‘tend to be the socially isolated in the classroom’. Both teachers, however, agreed that British Chinese students generally ‘do really well’ (Mr Tallman) and are ‘much better than average’ (Ms Smith), which would support the popular discourse of British Chinese students as academically ‘successful’ (Archer and Francis, 2005, 2007).

Similarly, science teachers also shared the view that ‘British Asian’ students were high or good performers (Abbas, 2002a). For instance, Mr Cartier (41, M, Black African, Barton) suggested that ‘British Asian’ students tend to do ‘really well’ because their parents have ‘high expectations for their kids’ and expect ‘their children to do their best in class’. In this case, perceptions from science teachers of ‘British Asian’ students may be shaped by the family educational discourse of ‘being the best’ (*see* Chapter 6) they believed to be prominent within ‘British Asian’ families. Although existing studies have differentiated Indian ‘achievers’, who were predominately Hindu and Sikh, from Pakistani and Bangladeshi ‘believers’, who were mainly Muslim (Archer, 2003; Modood, 1992), such distinctions were not obvious amongst the science teachers in this study (Crozier and Davies, 2008). As Ms Smith explained:

I don’t really tend to go around, you know, saying, ‘you’re from this country’, you know what I mean I don’t tend to distinguish them very much in my head’. (Ms Smith, 36, F, White Other, Barton)

On the one hand, the lack of specific views from science teachers such as Ms Smith toward ‘British Asian’ students may mark a departure from the demonisation of British Muslim students from Bangladeshi and Pakistani ethnic backgrounds (Crozier and Davies, 2008). For instance, Alexander (2000: 236) noted that the Muslim identity have “become the new ‘black’ with all the associations of cultural alienation, deprivation and danger that come with this position”. On the other hand, it should be noted that science teachers were not asked specifically on their views of Muslim students. Rather, science teachers expressed their own experiences of teaching students from various minority ethnic backgrounds. For instance, Ms Strauss (34, F, White English, Everest) recalled from her experiences of teaching Bangladeshi and Pakistani students that they tend to be ‘somewhere in the middle’ in

terms of achievement and progress. For Mr Denzin (45, M, Black African, Cranberry), Indian students tended to 'respond to instructions' due to the notion of 'respect' within the Indian community. In general, the views of science teachers toward British Chinese and 'British Asian' students seemed to reflect (and reinforce) popular views (*see* Chapter 2) of British Chinese and (particular groups of) 'Asian' students (e.g. Indian), who are typically regarded as high/good academic students (*see also* Chapter 6).

Whilst students from British Bangladeshi and Black Caribbean backgrounds dominated those who appeared to share a 'learning oriented' habitus and a family educational discourse of 'doing your best' (*see* Chapter 6), Black Caribbean students were typically seen by science teachers as the more (or most) disruptive of students who tend to 'leak' early from the science education pipeline (Elias *et al.*, 2006). As Mr Tallman remarked:

Certainly when you look at the Black Caribbean minorities, they, virtually every single one of them will drop out of science, certainly in Barton, and other teachers I know in other schools the chances of getting Black Caribbean to take up science to any great degree is virtually impossible, hmm, even if they're good at it they won't be interested in it. (Mr Tallman, 37, M, White English, Barton)

The use of the phrase 'virtually impossible' by Mr Tallman to describe the prospects of Black Caribbean students studying higher level science is striking given his later assertion that 'even if they're good at it they won't be interested in it'. For Mr Tallman, the lack of Black Caribbean students in science were not just a matter of achievement (Elias *et al.*, 2006) but could also be an issue of student identity (*see* Chapter 7). Consistent with existing literature (e.g. Crozier, 1999; Gillborn, 1990; Ferguson, 2000; Kelly, 2010; Strand, 2007), science teachers in this study were unanimous in their view that there were 'some issues' with Black Caribbean students, most notably 'behavioural' (Ms Smith) and being 'not motivated ... really badly behaved' (Mr Cartier), which were explained as due to a 'lack of role model or self esteem/aspirations' (Mr Denzin). Ms Strauss also found Black Caribbean students to be 'very relaxed' and 'laid back', which, as elaborated below, seems to

echo racist discourses of black pupils as ‘deviant’ students who ‘challenge authority’ (Gillborn, 1990; Sewell, 1997; Wright, 2010).

Although dominant racialised gender discourses may shape science teachers to view Black Caribbean girls as ‘a lot calmer’ (Mr Tallman), ‘more focused’ (Mr Cartier) and ‘less disruptive in general’ (Mr Denzin) than their male counterparts (*see* Morris, 2007), Mr Denzin suggested that Black Caribbean students, in general, tend to lack aspirations (e.g. ‘low level jobs’) as they ‘just don’t care’ and ‘that’s the normal way of life’ (Wright, 2010). In *‘Race’ Ethnicity & Education* (1990), Gillborn conceptualised the ‘myth of a Black Caribbean challenge to authority’ as “the belief that, as a group, [Black] Caribbean pupils presented a threat which was both quantitatively and qualitatively greater than any group of their peers” (p. 42). This belief was so widely held that teachers in Gillborn’s study – many of whom were from ‘white middle class’ backgrounds – found many expressions of Black Caribbean culture to be unacceptable and inconsistent with the values of the school (*see* Kelly, 2010, in the US context). As an example, Gillborn (1990) noted a particular style of walking common amongst Black Caribbean boys, with a “seemingly exaggerated swinging of the shoulders and a spring in the step” (p. 27), which was interpreted by teachers and the school as ‘challenging authority’. Consequently, such display of ‘black masculinity’ was often deemed as inappropriate and was therefore controlled by means of punishment and discipline (Gillborn, 1990; Sewell, 1997; Wright, 2010). Similarly, science teachers in the current study seem to have reproduced such popular racialised discourses in which Black Caribbean students, particularly boys, were seen as ‘challenging authority’.

For example, earlier comments from Ms Strauss (‘laid back’) and Mr Denzin (‘that’s the normal way of life’) also seem to have pathologised Black Caribbean students, which may reflect wider societal views towards the black population in Western societies. Bridgewater and Buzzanell (2010) found that the ‘laid back’ approach was interpreted as a positive attribute in ‘stressful work environments’ amongst Caribbean immigrants in the US. However, it appeared that within science teachers’ perceptions of student ‘personality’, the notion of being ‘laid back’ had negative connotations (e.g. being taken as evidence of low student aspirations). In other words, popular negative stereotypes of Black Caribbean pupils can generate lower

expectations from teachers and, in turn, can negatively influence the schooling experiences of Black Caribbean pupils (Gillborn and Mirza, 2000). In contrast to other ethnic groups, such as British Chinese and 'British Asian', where science teachers focused their views on students' ability to achieve and perform academically, Black Caribbean students appeared to be constructed by teachers through a problematic lens (Youdell, 2003). In this case, the discourses of 'valuing education' and 'doing your best', which many Black Caribbean students in this study seemed to occupy, may not be acknowledged by science teachers, whose general views toward minority ethnic students seemed to reflect (and reinforce) popular discourses (*see* earlier and Chapter 2).

Indeed, the views of science teachers towards minority ethnic students seem to correlate with the ethnic patterns in which students were categorised in the 'student engagement typology' (*see* Chapter 4). For instance, the dominance of Black Caribbean pupils who were categorised in the 'lower' ends of the 'student engagement typology' (e.g. *low engagement* in science, *see* Chapter 4 and Table 4.1) may be associated with the negative views science teachers tended to express towards Black Caribbean students. Similarly, science teachers often expressed positive views towards Chinese students, and Chinese pupils populated the 'higher' ends of the 'student engagement typology', particularly those categorised with *engagement without aspiration* in science (*see* Chapter 4 and Table 4.1). In this case, science teacher perceptions of minority ethnic students may have an influence on the ways in which minority ethnic students participate in, and engage with, science. However, the same cannot be said in relation to students' aspirations towards science-related careers. As a similar proportion of students across gender, class and ethnic backgrounds (except Chinese) expressed aspirations in science-related careers (*see* Chapter 4 and Table 4.3), one might speculate that science teachers' tendencies to draw on negative stereotypes and pathologising discourses of Black Caribbean pupils (for example) had limited influence on Black Caribbean students' aspirations for career identities in or from the science field. Likewise, only a minority of Chinese pupils expressed science-related career aspirations (*see* Chapter 4) despite receiving mostly positive views from science teachers. The final section of the chapter will now evaluate the notion of 'science identity' and its applicability for minority ethnic students in this study.

‘Science identity’: Is it useful?

In Chapter 7, the notion of ‘science identity’ was examined through inequalities and identity discourses of gender, ethnicity and class. In their perceptions of science and scientists, many students drew on gendered, racialised and/or classed discourses of science as ‘for men’, ‘for white people’ and/or as ‘oriented towards the middle class’. However, some students also shared egalitarian views of science as ‘for anyone’. A few students also utilised discourses of science which appeared contradictory, such as science was ‘for anyone’ but also just ‘for men’/‘for white people’ (see examples of Mani and Ronnie in Chapter 7). In light of this, some students’ identification with science seemed multiple and inconsistent, as ‘science identity’ can be shaped and reshaped by changing (and even conflicting) forces of influence. This section discusses the relevance of ‘science identity’ for students in the current study, drawing on the typology of ‘student science engagement’ (see Chapter 4).

For Carlone and Johnson (2007), a ‘science identity’ hinges on self-recognition as competent in science as well as “recognition by others as someone with talent and potential in science” (p. 1197). In this study, a ‘science identity’ would appear most open and sustainable for students categorised with *high engagement* in science, who possessed ‘high’ levels of achievement, interest and capital in science, as well as aspirations in science-related careers (and most probably recognition by science teachers as competent in science). In contrast, one might assume that students with *low engagement* in science would be least likely to be able to sustain a viable ‘science identity’, or command ‘science identities’, since they possessed ‘low’ levels of science achievement, interest, capital, and without aspirations in science-related careers (and most probably lacked recognition by science teachers as proficient science students). The notion of ‘science identity’ appears more complicated when attributed to students categorised with *wishful* or *ideological engagements* in science, and students considered with *engagement without aspiration* or *interest* in science. As discussed below, some students (e.g. those classified with *wishful* or *ideological engagements* in science) appeared to self-identify with science but lacked recognition of their ‘science identity’ by others. Whereas others seemed to achieve

and perform in science without personally identifying with the subject, such as those classified with *engagement without aspiration or interest* in science.

Shane (11, M, Black Caribbean, Barton), for example, was categorised with *ideological engagement* in science because his achievement was considered ‘low’ (see Chapter 4), yet he held science-related career aspirations (to become a scientist) and appeared to possess ‘high’ levels of science interest and capital. Science classroom observations of Shane also noted him showing interest and enthusiasm for experiments, and his individual interview transcript revealed that he possessed science cultural and social capital, through possession of experiment kits, watching science-oriented television programmes, and his uncle and cousins who worked and studied in science-related fields. However, Shane’s achievement in science was ‘low’ and thus he lacked academic competence in science (Carlone and Johnson, 2007). While Shane’s science teacher, Ms Smith (36, F, White Other, Barton), praised him as ‘good at practical’ and ‘he’s got the right questioning thing’ to ‘be a good scientist’, she also conceded that, ‘he’s got ... everything he needs to do well in science ... except for the fact that he can’t really read or write very well’. According to Ms Smith, ‘his written literacy is absolutely shocking and it holds him back in science’. So, even though Shane was commended as possessing a ‘science mindset’ by Ms Smith, demonstrated through his practical science skills, his achievement in science was undermined by his poor literacy skills. Indeed, Ms Smith sympathised that in Shane’s last science test, ‘his score was so low I couldn’t even give him a level’. In this case, the viability of a sustainable ‘science identity’ for Shane may not be fully recognised by his teacher as he was perceived to lack academic competence in science, despite his own personal identification with science and his aspirations to be a scientist. For Carlone and Johnson (2007), a ‘science identity’ is only sustainable through both self-recognition and recognition by others as competent in science. Thus it may appear challenging for Shane to maintain his ‘science identity’ (in the classroom, for instance) if his identification with science was not fully recognised by others such as his science teacher.

Students (e.g. such as Shane) categorised with *wishful* or *ideological engagements* in science *all* lacked science competence in terms of achievement, yet *all* aspired to science-related careers, which may be facilitated by personal interest(s) and through

expressing egalitarian discourses of science as ‘for anyone’. However, science competence may also reflect students’ self-concept/belief in their science abilities (Bandura *et al.*, 2001), which can vary from students’ actual achievement in science. At times during Shane’s interview, for example, he seemed to possess a high self-concept in his science abilities, as he boasted that only ‘Sam’ (his friend) and himself were ‘really really good at science’ in his class, and claimed that ‘me and him got a level 5C in science’, even though he stated ‘I get 4Cs’ in science earlier in his interview. In a discussion group with Black Caribbean students, Shane also appeared to have inflated his achievement in science and challenged the other participants that ‘I’m a 5A, what about you?’ However, as mentioned earlier, Shane’s science achievement was, according to his teacher, ‘so low’ that she could not grade him (e.g. below level 3 for Year 7, *see* DCSF, 2002). The story of Shane seems to support existing literature that found students’ perceived self-efficacy to be crucial in shaping their aspirations (Bandura *et al.*, 2001, Kerpelman *et al.*, 2008; Lyon, 2006), including in science-related careers (Cleaves, 2005), even if Shane was a ‘low’ science achiever (*see* Chapter 4).

For Shane, his self-identification with science may be sustained through his personal interest and self-efficacy in science, and/or through partial recognition from his science teacher who acknowledged Shane to be competent in practical activities and to have a ‘science mindset’. However, only time can reveal the extent to which a ‘science identity’ can be maintained without full recognition and legitimation from others (e.g. science teachers and educational grades/qualifications), as suggested in the ‘science identity model’ (Carlone and Johnson, 2007). Thus, students categorised with *wishful* and *ideological engagements* in science appear to identify with science on a personal level (through self-recognition), but without necessarily securing the competence or recognition normally required to make ‘science identity’ accessible and/or sustainable. In other words, despite their ‘high’ (or ‘medium’) levels of science interest and capital, and aspirations towards science-related careers, these students do not have a viable ‘science identity’ under Carlone and Johnson’s (2007) definition, because they lacked recognition by others (e.g. such as teachers) as competent in science. In this case, as sustainable ‘science identities’ appear highly dependent on students’ recognition by self and by others as competent in science,

one begs to question the importance of personal identification or interest with/in science within Carlone and Johnson's model of 'science identity'.

For students categorised with *engagement without aspiration* or *interest* in science, an identity in science may not be related to their stated career aspirations or interests. These students do not necessarily identify with science *per se*, but rather the social and cultural implications of achievement in science (or education in general). As discussed earlier in the case of Samantha and the discourse of science as 'for clever people', some students appeared to excel in school science for reasons other than science interest or science-related career aspirations (*see* Chapter 4). These students may regard high achievement in subjects considered 'high status', such as science, as providing them with more or better options in the future (Cleaves, 2005), such as in terms of choice of university or occupation. It is now suggested that the case of Samantha can refine Carlone and Johnson's (2007) model of 'science identity' in the sense of complicating what is meant by personal identification with science, which seems to be embedded/assumed within the dimension of self-recognition within the existing 'science identity model'. Samantha appeared to have self-recognition and recognition by others as competent in science, despite her apparent lack of personal/intrinsic interest in science.

For Samantha, her 'high' achievement in science and aspirations to study triple science seems to be associated with her desire to perform/show cleverness, where success in science was perceived to consolidate her status as a 'clever' person, which was also supported by her family educational discourse of 'being the best' (*see* Chapter 6). For Carlone and Johnson (2007), Samantha would appear to have a sustainable 'science identity' because she self-recognised and is recognised by others (e.g. by her science teacher, school acquaintances and academic grades) as a capable science student who is in the 'top set' for science, and who aspired to study triple science. Samantha's science recognition by others, such as her science teacher, also aligns with popular discourses of 'British Asian' (female) students as typically high achievers (*see* earlier; Shain, 2003). Although Samantha's 'science identity' seemed viable under Carlone and Johnson's (2007) definition, her personal identification with science was low/weak, since she expressed little/no interest in science or science-related careers. Thus, it is argued that Carlone and Johnson's 'science

identity model’ may need refining and clearer specification about what is meant by self-recognition in science, as engagement in science does not necessarily entail personal identification with, and intrinsic interest in, the subject area *per se*. Indeed, Samantha’s identification with science through ‘cleverness’ is also potentially more complex than the model currently recognises. In this case, despite fulfilling the criteria of self-recognition and recognition by others as competence in science (Carlone and Johnson, 2007), Samantha lacked a personal identification with science (e.g. she has no personal/intrinsic interest in science) and thus the viability of her ‘science identity’ may be open to discussion. What may be missing in the ‘science identity model’ as developed by Carlone and Johnson could be the markers of science aspiration and/or intrinsic science interest, and whether or not students’ aspirations towards science-related careers, or intrinsic interests in science, should constitute an element within the concept of ‘science identity’.

For instance, building upon the work by Carlone and Johnson (2007), Hazari *et al.* (2010) included the dimension of (intrinsic) ‘interest’ in their conceptualisation of ‘physics identity’, as interest in science/physics was argued to be “critically relevant in influencing the decision of who and what a student wants to be” (p. 982). In Carlone and Johnson’s (2007) ‘science identity model’, students with no aspirations and/or intrinsic interest in science can still have sustainable ‘science identities’ as long as they have self-recognition and recognition by others as competence in science. For Carlone and Johnson, students with self-recognition as competent in science may be assumed to have science interest and/or aspirations. More importantly, Carlone and Johnson did not seem to have made the distinction between students’ intrinsic and extrinsic interests in science, which, as seen in Samantha’s case, can complicate the ways in which students can ‘do’ science. Students such as Samantha may draw on the discourse of science as ‘for clever people’, where a ‘clever identity’ may be performed through the study of and achievement in science, and/or through the family educational discourse of ‘being the best’, where achievement (in science and in education) constitutes a part of what ‘people like me’ *do* (e.g. to achieve, *see* Chapter 6). In other words, their engagements in science are likely to be extrinsically driven and they may have no personal identifications with, and intrinsic interest in, science. Thus, the dimension of self-recognition as competent in science within Carlone and Johnson’s model of sustainable ‘science

identity' does not seem to fully explicate the complex ways in which students can identify with science. Although the 'science identity model' (Carlone and Johnson, 2007) can shed light into how students' identity in science may be sustained, the importance of 'science identity' for science engagement (or participation) could be examined further. To be precise, is it necessary for students to have a 'science identity' – that is, performance of competence in science that is self-recognised and recognised by others – in order to engage or participate in science? Can students engage in or aspire to science without a 'science identity'?

In the case of Shane, for example, his 'science identity' may be less viable as he lacked full recognition by others in terms of science competence (as his academic grades in science were 'low'), even though his science teacher acknowledged his competence in practical activities. However, Shane expressed a personal identification with science as he appeared interested in science and expressed career ambitions to be a scientist. His *ideological engagement* with science may also be facilitated through egalitarian discourses of science as 'for anyone', which posit that anyone can do anything. For students such as Shane, engagement in science does not necessarily entail the adoption of viable 'science identities', even if he had partial recognition from his teacher as being competent in science (e.g. only good at practical activities but not in written tests or academic examinations). For Samantha, her 'science identity' appeared sustainable since her competence in science was self-recognised and recognised by others, despite her lack of personal interest or aspirations in science (e.g. *engagement without aspiration or interest*). In this case, the relevance of 'science identity' for students such as Samantha, who stated little or no interest or aspirations in/towards science is debatable, even if they self-recognised and were recognised by others as competent in science. As can be seen, the model of 'science identity' as developed by Carlone and Johnson (2007) does not fully explain the multiple ways in which some minority ethnic students in this study 'do' science. The cases of Shane and Samantha may also shed light on inequalities of ethnicity, since Shane's Black Caribbean and Samantha's 'Asian' (notably Indian) backgrounds may be subject to specific teacher stereotypes of minority ethnic students (*see earlier*), as reflected in Shane's partial and Samantha's full recognition from science teachers with regards to their competence in science. As such, the sustainability of a 'science identity' appears to be conditioned by social inequalities,

such as ethnicity and gender (Carlone and Johnson, 2007; Marlone and Barabino, 2009; Ong, 2005).

Summary

The purchase of the ‘science identity model’ (Carlone and Johnson, 2007) was examined in this chapter through the dimensions of self-recognition and recognition by others as competent in science, focusing on students’ construction of science as ‘for clever people’ and the views of science teachers towards minority ethnic students. Although many students in the study expressed views of science as ‘for anyone’ (*see* Chapter 7) and as ‘for clever people’, the notion of ‘cleverness’ were inextricably linked by some students with males and masculinity. A sustainable ‘science identity’ may therefore be more challenging for girls than it is for boys (Carlone and Johnson, 2007; Marlone and Barabino, 2009; Ong, 2005). Drawing on the ‘student science engagement’ typology (*see* Chapter 4), a ‘science identity’ would appear most sustainable for those categorised in the ‘higher’ ends of the typology, particularly *high engagement*, because these students were most likely to self-recognise and be recognised by others (e.g. science teachers) as competent in science. On the other hand, students categorised in the ‘lower’ ends of the ‘student science engagement’ typology, such as *low engagement*, would seem least likely to have a viable ‘science identity’, since these students expressed little or no career aspirations related to science and were less likely to be recognised by others with science competence.

As discussed in the cases of Samantha and Shane, Carlone and Johnson’s (2007) model of ‘science identity’ does not neatly explain the experiences and identifications of all students in the current study. Students categorised with *ideological* or *wishful engagements* in science seem to self-identify with science without being fully recognised by others (e.g. such as their teachers) as competent in science. These students have aspirations towards science-related careers, even though their achievements in science were considered ‘low’, and thus their identifications with science were likely to be driven by personal/intrinsic interest in science. As Shane’s science teacher only acknowledged his science competence in practical activities, but not in academic examinations, the sustainability of his

‘science identity’ – which has partial, but not full, recognition by others – remains to be seen. Students categorised with *engagement without aspiration* or *interest* in science appeared to identify with science (through achievement, or competence) without science interest or aspirations, which may reflect the family educational discourse of ‘being the best’ (*see* Chapter 6) and/or the discourse of science as ‘for clever people’. Samantha, for instance, excelled in science, not because of personal interest or aspirations in science, but due to desiring the ‘clever’ identity she perceived as being available through the study of and achievement in science. In other words, she lacked personal/intrinsic identification with science and thus the extent to which her ‘science identity’ remains viable is also debatable. Although the dimensions of ‘self-recognition and recognition by others as competent in science’ constitute a useful foundation for understanding students’ ‘science identity’, this chapter has discussed some of the complexities and revealed the potential gaps in Carlone and Johnson’s (2007) model of ‘science identity’. In particular, one might question the significance of (intrinsic and extrinsic) science interest, science aspirations and students’ views of science in relation to ‘science identity’, and whether or not the adoption of a ‘science identity’ is a prerequisite for science engagement and participation. Thus, it seems apparent that the notion of ‘science identity’ is more complex than the dimensions of ‘competence, performance and recognition’ as proposed by Carlone and Johnson (2007), and further work is merited in relation to the role of science aspirations and interest within the notion of sustainable ‘science identities’.

Chapter 9 – Conclusion: Science aspirations across minority ethnic groups

Introduction

This thesis has investigated the science aspirations of British Black Caribbean, Pakistani, Bangladeshi, Indian and Chinese students (ages 11-14) in response to growing concerns over the general underrepresentation and underachievement of minority ethnic groups in British science education (Elias *et al.*, 2006). Age 11 to 14 has been identified as the period during which students' science views and aspirations appear to consolidate (Murphy and Beggs, 2005, Osborne, 2008; Tai *et al.*, 2006). This study addressed three research questions (*see* Chapter 3), aimed to unveil the ways in which minority ethnic students engage in, aspire towards and identify with science. The first question was concerned with the relationship between student achievements and aspirations, since aggregate achievements (e.g. at GCSE or A-levels) vary significantly across students from different minority ethnic groups (*see* Chapter 1; DfE, 2010a). The second question focused on the extent to which Bourdieu's notions of habitus and capital, and sociological theorisations of identity, can shed light on minority ethnic students' identifications and associations with science. Given that science and science-related careers have traditionally been viewed as privileges for the elite, such as 'white middle class men' (Baker, 1998), the third question queried how cultural identities and inequalities of gender, class and ethnicity may influence minority ethnic students' views of and aspirations in science.

As discussed in Chapter 2, this study was sociologically informed and focused on the intersections between gender, class and ethnicity as forces of influence in shaping students' views of, and aspirations towards, science. Bourdieu's (1977, 1986) conceptual tools were employed as an exploratory lens to test the applicability of his notions of habitus and capital in the context of science aspirations and identifications amongst minority ethnic students (*see* Chapters 4, 5 and 6). The notion of identity – particularly 'science identity' (*see* Chapters 7 and 8) – was also relevant, especially with respect to dominant images of scientists/science as typically seen as a field of, and for, the archetypal 'white middle class men' (Baker, 1998).

Given the research aims, a qualitative approach was adopted as a means to explore the science views and aspirations of minority ethnic students. As stated in Chapter 3, the main research method was the semi-structured interview, conducted with students (n=46), their science teachers (n=5) and one parent. A number of the students (n=16) were observed in science classrooms for a total of 22 hours. In addition, six focus group discussions were held with students from the same ethnic backgrounds. The findings in this thesis were primarily based on the discourses that the 46 minority ethnic students in the study were able to produce during their interviews. The data were analysed through the social axes of gender, class and ethnicity as well as the notions of habitus, capital and sociological theorisations of identity, to unravel the ways in which minority ethnic students construct, aspire to, and identify with, science.

Chapter 9 brings together the findings reported in the study, which attempted to explain why members of some minority ethnic groups identify with science while members of other groups do not. In this chapter, a summary of the research findings is first presented in relation to the research questions this thesis set out to investigate. The implications and scope of the study are also discussed, concluding with some thoughts for future research.

Summary of research findings and contributions to knowledge

Little, if any, research in the UK has explored the science views of 11- to 14-year-old minority ethnic students. The current study contributes to this gap in knowledge by providing new data and analyses of the science aspirations and identifications of British Black Caribbean, Bangladeshi, Pakistani, Indian and Chinese students at Key Stage 3. Three key areas of contribution are now discussed.

(i) Development of a 'student science engagement' typology

The first research question in the study examined the relationship between students' science achievement and their aspirations towards science careers. A preliminary analysis of student interview data found **no obvious relationships between**

students' academic grades and their stated career ambitions, as a similar proportion of students categorised with 'high', 'medium' and 'low' levels of science achievement (with regards to students' expected grades in their respective year groups, *see* Chapter 4; DCSF, 2002) expressed science career aspirations. According to St Clair and Benjamin (2011), it is often assumed that low aspirations lead to low achievement and thus the aim of raising aspirations is "to break a perceived link between low aspirations and the lack of educational achievement for students who live in poverty" (p. 502). However, in line with Strand and Winston (2008), who found that minority ethnic students possess high educational aspirations (despite some being low academic achievers), this study found that aspirations for science-related careers can also operate independently from minority ethnic students' science grades.

Drawing on science classroom observations as well as student interview data, Chapter 4 **mapped out the different ways that minority ethnic students associate with science** by considering not only students' achievement and aspirations in science, but also their **science capital and science interest**. Capital in science was understood as science-related resources available to students, which could be in the form of economic, social and cultural capital. Interest in science was subjectively determined by the researcher through available data of individual students, which was primarily based on their stated liking and disliking of science in and out of school. A '**student science engagement**' **typology** was developed to illustrate the various ways in which minority ethnic students in the study engaged with science through the markers of science achievement, science aspiration, science interest and science capital. Although the values of these markers (e.g. as 'high', 'medium' or 'low') were only indicative and by no means definitive, the typology provided a useful platform and a helpful frame of reference for further explorations into why students may engage with science in particular ways (*see* Chapters 5 and 6). The typology showed how **some minority ethnic students appeared to engage and achieve in science without apparent interest or aspirations while other students expressed aspirations in science-related careers despite being 'low' achievers**.

The majority of Black Caribbean and Bangladeshi students were categorised at the 'lower' ends of the typology (e.g. *low engagement* and *wishful engagement* in

science), which may reflect their ‘early leak’ from the science education pipeline (Elias *et al.*, 2006). Black Caribbean students populated the *low engagement* category, where students have ‘low’ levels of achievement, interest and capital in science, and aspirations in non-science-related careers. In other words, Black Caribbean students tend to have little (if anything) in common with science as it is presented to them at school and in the media (Calabrese Barton *et al.*, 2001). Students categorised with *wishful engagement* in science tended to be from Bangladeshi ethnic backgrounds, and they all expressed science-related career aspirations despite their ‘low’ achievement and capital in science. The discrepancy between attainment and ambition may be explained through the ‘aspiration-achievement paradox’ (DeWitt *et al.*, 2011a; Mickelson, 1990), which posited that these students lacked the know-how to realise their aspirations. On the other end of the spectrum, Indian and Chinese students populated the ‘higher’ ends of the ‘student science engagement’ typology (e.g. *high engagement* and *engagement without aspiration* in science), which mirrored their overrepresentation in post-compulsory science education (Elias *et al.*, 2006). Indian and Chinese students tended to be ‘high’ achievers in science even when they expressed no career aspirations towards science-related fields.

As this thesis has demonstrated, **minority ethnic students have diverse achievements, aspirations and engagements in/with science**. It is therefore important for researchers and policy-makers in science education to acknowledge the diversity that exists amongst minority ethnic students in order to devise strategies/initiatives that is appropriate/effective for different students (e.g. such as the seven ‘types’ as proposed in the ‘student science engagement’ typology, *see* Chapter 4 and Table 4.1) in relation to their science participation (*see* ‘Messages for policy and science education’ later).

(ii) Applying Bourdieu to field of science education

In this study, the conceptual tools of Bourdieu (1977, 1986) were employed as an exploratory lens to test their applicability in the context of science education and identity – particularly his notions of habitus and capital – when exploring the resources available to particular ethnic groups and how the possession of capital may

privilege certain groups in various identifications and performances (e.g. in science). As Bourdieu's work has not been extensively applied in the field of science education, this study has utilised a relatively novel approach which crosses sub-disciplinary boundaries of sociology of education and science education. In this section, the applicability of Bourdieuan concepts is discussed in the context of minority ethnic students and the different ways in which they engage and participate in science. The notion of science capital, which also informed the 'student science engagement' typology, was analysed further in Chapter 5 through the dimensions of economic, social and cultural capital. In particular, the concept of *quality* was proposed in relation to the role of social capital in shaping students' science aspirations, as particular forms of social network (e.g. knowledge of someone *in* the science field) appeared to have a greater influence over others (e.g. knowledge of someone aspiring *to* the science field). Drawing on the family discourses of 'being the best' and 'doing your best' in education which students in the study seemed to share, the formation of the habitus as 'achievement oriented' and 'learning oriented' was developed in Chapter 6, which also appeared to shed light into the tendency of students from Black Caribbean and Bangladeshi backgrounds to be categorised in the 'lower' ends, and Indian and Chinese students to be categorised in the 'higher' ends, of the 'student science engagement' typology.

The notion of science capital was understood as resources available to students that were science-related and it was explored in Chapter 5 in relation to economic, social and cultural capital.

For the deployment of economic capital (e.g. the provision of private tuition) Indian and Chinese students in the study predominated amongst those who claimed to receive private tuition, irrespective of their class backgrounds. The ability of Indian and Chinese students (and their families) to utilise economic capital may reflect their family/ethnic backgrounds and ideologies, where educational success was often seen as the main/only vehicle for upward social mobility (Archer and Francis, 2007; *see also* Chapter 6). Indeed, the tendency of Indian and Chinese students to possess an 'achievement oriented' habitus, facilitated by the family educational discourse of 'being the best' (*see* Chapter 6), may also provide some explanation for their willingness to purchase private tuition even when economic capital was scarce

(Archer and Francis, 2007). In this case, **Bourdieu's reproduction theory of social class inequality may be complicated/mediated by ethnicity and family backgrounds** (Archer, 2010, 2011), as some 'working class' students from minority ethnic backgrounds were able to utilise resources (e.g. using economic capital to buy private tuition) traditionally associated with the 'middle classes' (Smyth, 2009).

Science social capital was understood as the ways in which students' science and career aspirations may be encouraged, influenced or inspired by/within their social network. This study has **extended and refined Bourdieu's concept of social capital through the distinction of quality**. The notion of *quality* (*higher quality* and *lower quality* science social capital) was proposed in Chapter 5 to differentiate between students' knowledge of someone *in* a science career (i.e. *higher quality*, such as extended family members) and students' knowledge of someone aspiring *to* a career in or from science (i.e. *lower quality*, such as peers). Indeed, *higher quality* science social capital can also permit some students to view the science route as 'known', and even 'safe', because 'success' in science (e.g. in a career or in education) has already been achieved by someone who is known to them (e.g. extended family members). The home sphere (including the extended family) appeared to exert significant influence over the ways in which minority ethnic students approached science and education and, to some extent, the type of careers students were expected to aspire to (which tends to be supported by *higher quality* social capital). However, the influence of peers on students' science career aspirations appeared limited and was considered as a *lower quality* science social capital since friends were less likely (at this age at least) to be *in* the science field with first-hand experiences or knowledge. Thus, **it was argued that peer influence was minimal in relation to students' formation of science career aspirations**.

The distinction between *higher quality* and *lower quality* social capital may reflect Skegg's (2004) notions of exchange-value and use-value, where some capital (e.g. *lower quality* science social capital) may only have (use-)value within a particular domain (e.g. in relation to students' science aspirations), but with little or no (exchange-)value in other spheres (e.g. in relation to students' science cultural capital or knowledge/competence). By the same token, *higher quality* science social capital appeared to have more exchange-value than *lower quality* science social

capital, at least in terms of students' first choice career aspirations, since students in the study with *higher quality* science social capital were more likely to state science-related career aspirations (also as a first choice) than students with *lower quality* science social capital, who tended to express aspirations for non-science-related careers (as their first choice) instead. However, *higher quality* social capital should not be synonymised with exchange-value, because knowledge or contacts from members of the extended family, for example, may not have an exchange-value but only a use-value (e.g. valuable only within a specific/local community, but not wider society). In other words, *higher quality* social capital does not necessarily have exchange-value, even though *lower quality* social capital may only have use-value. In this case, the notion of *quality* in relation to social capital can be seen as a useful way of thinking about the influences/values of different social networks (e.g. extended family members, various peer groups) in shaping students' science and career aspirations.

In support of Bourdieuan theory, a classed difference also emerged, with 'middle class' students being proportionally more likely to possess *higher quality* science social capital than their 'working class' counterparts, who tended to command *lower quality* science social capital, such as knowledge of peers with science-related career aspirations. Similarly, students from 'middle class' backgrounds tended to possess a wealth of science cultural capital in comparison to 'working class' students, even when no aspirations towards science-related careers were expressed. In this case, **Bourdieu's assertion of class advantage appeared to take hold amongst minority ethnic groups, but only in relation to social and cultural capital.**

While most students in the study seemed to have some form of science cultural capital – notably, the watching of science-oriented television programmes – students with 'science-knowledgeable' parents appeared most likely to express science-related career aspirations (as well as being categorised as 'high' science achievers). Indeed, the notion of *quality* may also be applicable here as 'science-knowledgeable' parents may be considered as a *higher quality* form of science capital (i.e. personally known to students). As the vast majority of students with 'science-knowledgeable' parents held science career aspirations, there may be scope for science interventions

to target parents as a way to disseminate knowledge about careers in or from science in an attempt to introduce these as thinkable routes within the family discourses.

Although students categorised with a ‘high’ level of science capital were the most likely to express science-related career aspirations and to be categorised as a ‘high’ achiever in science (*see* Chapter 4, Tables 4.7 and 4.8), there were minimal gender and social class differences, even though **an ethnic disparity was found in relation to students’ access to science capital** (*see* Chapter 4 and Table 4.6). Indian students in the study were most likely to have access to high levels of economic, social and cultural capital related to science (Wong, 2011). This study suggests that British students with an Indian background are an interesting case and further research is merited given the dearth of literature focusing on the educational experiences of British Indian students (e.g. Bhopal, 2011).

However, science capital available to students may not always be utilised. For Bourdieu (1977, 1986), capital can be convertible resources that can yield advantages for their holders. Yet, he seemed to have assumed that all forms of legitimate capital can be successfully converted and utilised by holders in self-beneficial ways. According to Coleman (1988, 1990), the *process* of knowledge and resource transmission (e.g. between parents and children) must be examined and not assumed. Thus, Coleman’s theory of ‘family social capital’ can potentially complement and refine Bourdieu’s (1977, 1986) notion of social capital. Similarly, in Chapter 5, the concept of *under-utilised (social or cultural) capital* was proposed to account for students who appeared to possess, but did not utilise, available resources related to their science and career aspirations. Existing scholars have warned that the convertibility of some capital may be community specific (e.g. within minority ethnic groups), with little or no exchange-value in the dominant society (Carter, 2003; Skeggs, 2004). Thus, further research is necessary to explain why some students in the study appeared to refuse, or under-utilise, available capital related to their career aspirations.

Habitus was conceptualised by Bourdieu (1977) as the unconscious (or ‘natural’) ways in which individuals come to think and act, as shaped and influenced by their past, present and embodied experiences of the social world. In this study, the notion

of habitus provided a powerful way of thinking about minority ethnic students and their engagements in science and education. **The formation of the habitus as ‘achievement oriented’ and ‘learning oriented’ was conceptualised** in Chapter 6 through the family discourses of ‘being the best’ and ‘doing your best’ in education, which attempted to provide explanation for the different ways in which students were socialised with particular forms of educational, science and/or career aspirations.

Students with an ‘achievement oriented’ habitus internalised top academic attainments (and, in some cases, ‘high status’ career aspirations) as ‘normal’ and expected (e.g. strive towards ‘being the best’), as something ‘people like me’ *do*. **Indian and Chinese (and Pakistani) students dominated those who appeared to share an ‘achievement oriented’ habitus**, which may also provide some explanations for the dominance of Indian and Chinese students being categorised in the ‘higher’ ends of the ‘student science engagement’ typology (e.g. *high engagement* and *engagement without aspiration or interest* in science, see Chapter 4). For instance, some students could achieve and engage in science without personal interest or aspirations in science, since educational accomplishment may merely reflect what ‘people like me’ *do* (as achievement in science may merely constitute a part of the overall goal in ‘being the best’).

Students with a ‘learning oriented’ habitus were more concerned with ‘doing your best’ in education, with the emphasis on the *process* of learning, rather than the actual *outcome* from learning (i.e. achieved grades). Students may have *desirable* but not *expected* outcomes, similar to students categorised with *wishful* or *ideological engagements* in science, whose aspirations in science appeared to operate independently from their science achievement. **Many Black Caribbean and Bangladeshi students in the study seemed to share a ‘learning oriented’ habitus**, which may shed light into their tendency to be categorised in the ‘lower’ ends of the ‘student science engagement’ typology (e.g. *low engagement*, *wishful* or *ideological engagements* in science, see Chapter 4).

Thus, in a similar pattern to the ethnic disparity between students categorised in the ‘higher’ and ‘lower’ ends of the ‘student science engagement’ typology, many Indian

and Chinese (and Pakistani) students appeared to possess an ‘achievement oriented’ habitus, whereas many Black Caribbean and Bangladeshi students seemed to possess a ‘learning oriented’ habitus. In this case, differences in habitus (as ‘achievement oriented’ or ‘learning oriented’) may shed light onto why some minority ethnic students appeared to engage in science while others did not.

Bourdieuian theory sets out to explain the reproduction of social class inequalities. However, in the current study, ethnicity and family discourses appeared to have complicated the influence of class. In other words, the reproduction of classed habitus (e.g. social class position) may not operate in the same way for minority ethnic groups as for the white British (Archer, 2010, 2011). Indeed, the habitus of some minority ethnic ‘working class’ students was not reproductive, but responsive, to the experiences and aspirations of the family. For instance, parental lack of educational opportunity or the social cost of migration may have inspired and motivated some students to achieve academically. In this study, the use of Bourdieuian concepts – namely, habitus and capital – provided a sociological analytic lens for understanding the differences between minority ethnic groups and their science and career aspirations.

(iii) Complicating the notion of ‘science identity’

This study also critically engaged with the notion of ‘science identity’. Chapters 7 and 8 drew and developed on the **‘science identity model’** proposed by Carlone and Johnson (2007) and examined how identities and inequalities of gender, class and ethnicity might influence students’ constructions, perceptions and identifications with science. According to Carlone and Johnson, the conditions for a sustainable ‘science identity’ were self-recognition and recognition by others as being competent in science. Chapters 7 and 8 contributed to the current debate and theories of ‘science identity’ by **questioning the relevance of the concept of ‘science identity’ for students who appeared to engage and achieve without apparent interest or aspirations in science.**

Chapter 7 **mapped the discourses students drew on in their views of science/scientists** – notably, egalitarian discourses of science as ‘for anyone’ and the

stereotyped discourses of science as a field for ‘white middle class men’. Some students articulated views of science that appeared contradictory, such as science was ‘for anyone’ but also ‘for men’, which highlighted the complexity and fluidity of science discourses available to students. Minority ethnic students who only articulated egalitarian discourses of science were comparatively more likely to express science-related career aspirations than students who expressed views of science that implicated gender, class or racial stereotypes of science/scientist as ‘white middle class men’. In other words, students who only expressed egalitarian views of science were more likely to self-identify with science through their aspirations towards a science-related career, as **egalitarian views of science seem to correspond with aspirations towards science-related careers**. Such a finding may extend Carlone and Johnson’s ‘science identity model’, particularly the dimension of self-recognition in science. It was argued that students’ views of science through egalitarian/stereotyped discourses could influence the ways in which students come to recognise themselves (or have self-recognition) in relation to the science field.

It was argued that the other key dimension of the ‘science identity model’, **recognition by others as competent in science, is racialised**, and this was investigated through the views of science teachers toward minority ethnic students (*see* Chapter 8). Reflecting participation statistics which show minority ethnic students as leaking from all stages of the science education pipeline (Elias *et al.*, 2006), science teachers in the study believed that Black Caribbean students were the least likely, while Chinese and ‘British Asian’ (understood as predominately Indian, Pakistani and Bangladeshi) students were the most likely, candidates to progress or achieve in science education. For example, Black Caribbean students were stereotyped by science teachers as typically disruptive and low achieving, whereas Chinese and ‘British Asian’ students were characterised as hard working, obedient and high achieving (e.g. Archer and Francis, 2007; Gillborn, 1990; Shain, 2003). In other words, **science teachers’ stereotypical perceptions of minority ethnic groups seemed to reinforce the existing ethnic patterns in science participation and achievement** (DfE, 2010a; Elias *et al.*, 2006). Thus, it was argued that for some minority ethnic students, their ethnicity could pose a challenge to their recognition by others (such as teachers) as being scientifically competent (e.g. Black Caribbean; *see also* Marlone and Barabino, 2009; Ong, 2005). It may be worthwhile then for

science educators to consider ways to challenge and dispel some of these racialised viewpoints (as expressed by science teachers) in order to broaden the potential of sustainable ‘science identities’ for students across different ethnic groups (e.g. in terms of recognition by others as competent in science).

In Carlone and Johnson’s (2007) ‘science identity model’, students with sustainable ‘science identities’ must be able to engage with science in a way that is self-recognised and recognised by others. This study has **questioned some aspects of Carlone and Johnson’s model of ‘science identity’**, notably the dimension of self-recognition and the relevance of ‘science identity’ for students who appeared to have little or no interest or aspirations in science, despite fulfilling the criteria of recognition by self and by others as competent in science. For example, some students (e.g. Shane, *see* Chapter 8) recognised themselves, but were not fully recognised by others, as competent in science, yet they were able to engage in science through personal interest and science career aspirations, despite their lack of sustainable ‘science identities’. Other students (e.g. Samantha, *see* Chapter 8) demonstrated self-recognition and recognition by others as scientifically competent and appeared to possess a sustainable ‘science identity’, yet they had no personal interest or aspirations towards science. Their engagement, achievement and self-recognition in science may be explained as part of their performance of cleverness, which they perceived to be available through the successful study of (and achievement in) advanced level science (e.g. triple award science). In other words, their engagement in science may be facilitated by discourses and identities that promote (only) academic achievement (such as the family educational discourse of ‘being the best’ and a ‘good student’ identity, which encouraged students to perform ‘intelligence’ through achievement). For these students, who were mainly categorised with *engagement without interest or aspiration* in science (*see* Chapter 4 and Table 4.1), their engagement and achievement in science were likely to be extrinsically driven and they may share no interest or aspirations in/towards science. However, in the ‘science identity model’ (Carlone and Johnson, 2007), science career aspirations and interest may be assumed for students who have self-recognition in science, but as shown in Chapter 8, **a desire to perform cleverness can also enable students to engage with science.**

As can be seen, the relationship between ‘science identity’ (as outlined by Carlone and Johnson, 2007) and science engagement merits further investigation, as some students such as Shane (*see* Chapter 8) appeared to engage in science without necessarily possessing a sustainable ‘science identity’, while other students such as Samantha (*see* Chapter 8) seemed to possess a sustainable ‘science identity’ despite expressing little or no interest or aspirations in/towards science-related careers. Thus, Carlone and Johnson’s ‘science identity model’ may wish to incorporate students’ science interest and aspirations, as the current model seems to imply that students with sustainable ‘science identities’ have personal science interest as well as aspirations towards science-related careers, which this thesis suggests is not always the case.

Messages for policy and science education

In this section, the implications of the research findings are considered in light of the ‘student science engagement’ typology developed, suggesting how science policy-makers and educators might develop initiatives to target specific categories of students to enhance their options in science. Although students categorised with *low engagement* in science seem to have already ruled out science as a field for study or as a career, students in the other six categories of the ‘student science engagement’ typology have all expressed or demonstrated some form of science engagement, such as aspirations and/or ‘high’/‘medium’ achievement in science. This study has six key messages for policy and science education. The first four messages are interrelated and could be enacted together.

Message 1 – Addressing the ‘aspiration-achievement paradox’: Raising attainment

Although minority ethnic groups are generally underrepresented in the field of science, this study found that students across gender, class and ethnic backgrounds expressed high status and/or science-related career aspirations, irrespective of their current educational achievement. In other words, one might question the value of educational initiatives aimed at ‘raising’ the aspirations of minority ethnic groups as these students, in this study at least, do not appear to suffer from the popularly assumed ‘poverty of aspirations’. In this case it is suggested that educational policies

be usefully reconfigured to focus on how students could realise their aspirations, such as raising achievement, rather than raising their ambitions in order to address the ‘aspiration-achievement paradox’ that appears to plague particular minority ethnic groups (notably Bangladeshi students in this study). DeWitt *et al.* (2011a: 263) suggest that:

The issues underlying the aspiration-achievement paradox (Mickelson, 1990) will require support and intervention at a structural level ... [which] could be through targeted support to help minimise the aspirations–achievement gap within particular communities where there are existing high aspirations ... but where achievement tends to lag behind.

It is also notable that students categorised in the ‘lower’ ends of the ‘student science engagement’ typology, particularly those with *low engagement* in science, tended to be from Black Caribbean backgrounds (*see* Chapter 4). From the perspective of equity in science, wider social inequalities may be curtailing students from particular ethnic backgrounds from progressing/achieving in science education (Carlone and Johnson, 2007; Marlone and Barabino, 2009; Ong, 2005). For instance, Black Caribbean pupils were often negatively stereotyped by science teachers as low achieving and disruptive students (*see* Chapter 8; Gillborn, 1990; Wright, 2010). As suggested earlier (*see* ‘(iii) Complicating the notion of ‘science identity’”), science educators/teachers could be encouraged to actively challenge and dismiss popular stereotypical perceptions and expectations of students from particular minority ethnic backgrounds. Moreover, from the perspective of scientific literacy, a challenge remains for science policy-makers and educators to engage students categorised with *low engagement* in science – who lacked aspirations in science-related careers and have ‘low’ levels of science achievement, interest and capital, and who tended to be from particular minority ethnic backgrounds (e.g. Black Caribbean).

Message 2 – Deconstructing ‘science identity’: Not just academic competence

Despite the need to raise achievement, there is also scope for policy-makers to capitalise on students’ interest or aspirations in science by publicising science career

routes that are less determined by academic achievement. In other words, some students may benefit more from having knowledge of the diverse range of options available to them after compulsory education (e.g. such as apprenticeship and vocational study), rather than following the conventional ‘gold standard’ routes of studying A-levels or university degrees. Some students, such as those categorised with *wishful* or *ideological engagement* in science, lacked science competence despite their ‘high’ levels of interest or aspirations in science. To support their science participation, science interventions could be steered towards the applied elements of science skills and knowledge, such as practical competences. Such an approach could promote and facilitate a broader range of non-academically oriented ‘science identities’ and may also help dispel the image of science as exclusively for those who are highly academically competent. Science education policy-makers and teachers could promote and acknowledge a broader range of ‘science identities’ and careers in/from science available to students, moving away from the traditional model of ‘science identity’, which seems to emphasise high educational attainment or competence (Carlone and Johnson, 2007).

Message 3 – Deconstructing ‘science identity’: Not just ‘white middle class men’

In a related vein, Chapter 7 found identities of gender and ‘race’/ethnicity influenced the science aspirations of minority ethnic students, as students with gender or racially stereotyped science views (i.e. science as ‘for men’ or ‘for white people’) were less likely to express science-related career aspirations than students who expressed egalitarian views of science (as ‘gender/racially equal’). This finding points to the continued influence of stereotypical images of scientists on student aspirations. Thus, efforts might be expended on deconstructing the popular gendered and racialised image of science and scientists (e.g. as ‘for white men’). Such a task, however, is by no means easy, especially since popular media portrayals of scientists continue to reinforce the ‘white middle class male’ stereotype (Chimba and Kitinger, 2010; Mendick *et al.*, 2008).

Within school science, science educators may need to acknowledge the traditional views of science (e.g. as a field for ‘white middle class men’) while also rejecting such stereotypes by promoting the diversity of the science field. In other words,

science educators could actively encourage students not to view science careers as exclusive to any particular social groups (e.g. *see* Scherz and Oren, 2006), since such perceptions could encourage students' self-exclusion from science. However, it is acknowledged that science graduates (and therefore potential future scientists) from minority ethnic backgrounds, especially those in the physical sciences, continue to be heavily underrepresented in the UK (Elias *et al.*, 2006). Indeed, Smith (2009) found that the vast majority (e.g. 86% in 2007) of physical science students at UK universities to be white (and predominately male and 'middle class'), and such patterns have changed little over the last 25 years. Thus, although stereotypical views of scientists as 'white middle class men' seem to have a negative influence on minority ethnic students' aspirations towards science-related careers, it is recognised that efforts to deconstruct such popular images of science/scientists would not totally 'solve' the 'crisis' in science participation rates concerning girls and (particular groups of) minority ethnic students (Elias *et al.*, 2006). There are still wider, structural equality issues to be addressed, such as the continued dominance of 'white middle class men' in the study of physical science degrees.

Message 4 – Opening up students' view of careers in and from science

Students considered to have *medium engagement* in science expressed aspirations towards science-related careers, but the majority mentioned them as a second choice (i.e. their first choice career aspiration was non-science-related). Students across all minority ethnic backgrounds were represented in this category. These students generally possessed 'medium' levels of interest, capital and achievement in science and could be seen as the undecided group in relation to their trajectories in science education. As such, science interventions may wish to target this group of students in their promotion of science-related careers as a way to offer undecided students who have academic potential and/or personal interest in science a broader knowledge of the careers and educational options available through the study of particular sciences at GCSE, A-level and beyond.

Indeed, most students in the study seemed to have a very narrow view of science careers, such as scientists or medical professionals (Scherz and Oren, 2006). In this case, there is also the scope for science educators to inform students of the range of

careers available from the study of science (Osborne and Collins, 2000; Osborne and Dillon, 2008).

Message 5 – Retaining the scientifically competent in science education

Students categorised with *engagement without aspiration* or *interest* in science tended to have little or no interest in or aspirations towards science, despite often being considered as ‘high’ science achievers. For these students, achievement in science may be part of their overall goal to achieve academically, irrespective of the actual subject (e.g. ‘achievement oriented’ habitus). For some, a ‘clever identity’ was also evident through the study of and achievement in science. Students categorised with *engagement without aspiration* or *interest* in science may attract less attention from policy-makers because they appear ‘successful’ in school science due to their ‘high’ achievement. However, these students are not immune to leaking from the science education pipeline, although their disengagement from science may happen at a later stage, such as in higher education (Elias *et al.*, 2006). Although students categorised with *engagement without aspiration* or *interest* in science are likely to continue studying science until they no longer see it as extrinsically valuable, science educators could target this group of students and work with them to develop ways in which science can be seen to be more enjoyable or approached with intrinsic as well as extrinsic motivation.

Indeed, if science educators are keen to recruit the most capable personnel in science, then policy-makers ought to identify ways in which to enhance the science interest and aspirations of these competent science students. Likewise, the dominance of Indian students categorised with *high engagement* in science does not necessarily mean that Indian students are the least likely group to disengage from the science education pipeline. In line with Message 4, the science career aspirations expressed by Indian students in the study were overwhelmingly medical related, which suggests that their views of careers available from science may be very narrow and even restricted to the medical profession (e.g. doctors and pharmacists, see Springate *et al.*, 2008; Wong, 2011). Elias *et al.* (2006) found that British Chinese students were the only minority ethnic group to be proportionally overrepresented in the study of undergraduate physics in UK universities. In this

case, the study of and achievement in school science (e.g. triple science, A-level) amongst Indian students may merely be a stepping stone en route to their goal of a medical career, which means that in science disciplines such as physics (e.g. at degree level), there would continue to be an underrepresentation of scientifically competent minority ethnic groups, such as British Indian students. As suggested in the next section, future research could explore how Indian and Chinese students approach and experience science when they are in higher education.

Message 6 – More research on/with minority ethnic groups

The findings reported in this thesis suggest that school students from minority ethnic groups have diverse experiences in science education, even in the context of 46 minority ethnic students in London. Policy-makers need to recognise and acknowledge variations within and across minority ethnic groups, as these students are far from homogeneous in their experiences of science and education. Further research could examine the apparent ‘success’ of Indian and Chinese students in the science education pipeline – at least until they reach university (Elias *et al.*, 2006) – as few studies have focused on the science experiences of these minority ethnic groups in the context of UK higher education. The very few studies that have explored the ‘success’ of minority ethnic groups were conducted with school aged pupils and without reference to specific subject areas (e.g. Archer and Francis 2007). Thus, more research with minority ethnic groups may well be beneficial for the science education field and would expand our current understandings of the science experiences and participation of minority ethnic groups. The next section will discuss the scope of the study and implications for future research.

Reflections on the research and further study

Over the course of the study, a number of issues have shaped the data collection and the research findings, which have inevitably constrained the range of analyses and the implications of the study. For instance, the participants in this study came from London schools, which tend to be ethnically diverse. The science experiences of minority ethnic students from different cities or even in ethnically homogeneous schools may differ considerably. Indeed, as a small-scale qualitative study, the extent

to which my findings can be generalised or applied in other contexts (e.g. location) or to other ethnic groups should be treated with extreme caution. This final section provides a reflection on the overall research study, focusing on the methodology and scope of the thesis as well as some thoughts for future research in the areas of ethnicity and science aspirations.

Although urban and suburban schools were approached as a way to recruit students from different socioeconomic backgrounds, the overwhelming majority of students in the study were categorised as coming from ‘working class’ backgrounds. Only eight students were considered to be ‘middle class’ and this group was dominated by Indian and Chinese students. The minority ethnic ‘middle classes’ are an under-researched group (Archer, 2010, 2011) in general and in the current study, the small number of minority ethnic ‘middle class’ students restricted analysis regarding the differences between the science experiences of ‘middle’ and ‘working class’ students, particularly regarding differences within the ‘middle class’. Thus, a future larger number of ‘middle class’ participants from a spread of minority ethnic backgrounds could enrich the analysis of (‘middle’) class influence on minority ethnic students’ science aspirations and engagements.

Unlike the dominance of ‘working class’ students in the study, a balance was generally achieved in relation to students’ gender and ethnicity, with the exception of Bangladeshi students, which were dominated by boys (one girl; eight boys), and Pakistani students, with only five participants (in comparison to at least nine participants in each of the other minority ethnic groups). Although attempts were made during recruitment to balance the proportion of students from various gender, class and ethnic backgrounds, the final number of participants and their demographic backgrounds depended on those who had signed consent from parents to participate in the study. It would be interesting to explore further the science career aspirations of Bangladeshi girls in light of the findings from Smart and Rahman (2009), who found that Bangladeshi parents were supportive of their daughters in careers associated with maths, chemistry and biology, but not in physics, technology or engineering. Unlike the girls in Smart and Rahman’s study, the one Bangladeshi girl included in this study (Fay) aspired to be ‘famous’ through a career in the entertainment industry, while her mother had ambitions for her to be a ‘big

businesswoman'. Fay's career aspirations appeared to be influenced by her desire to perform hetero-femininity (*see* Chapter 7). Thus, the potential exists for future research to explore the variability within the influences of gender and ethnicity on students' science career aspirations.

In addition to the previously mentioned issues concerning the recruitment of student participants, great difficulty was encountered in recruiting their parents to take part in the research. Minority ethnic parents proved notoriously difficult to recruit in this study. Only one parent (of the 46 students) agreed to participate. In this study, parents were separately invited to participate after their child was interviewed through a letter given to students (to be passed on to their parents) immediately after their interviews. Such a technique unfortunately increased the layers of communication between the researcher and the target participants (i.e. parents), with student participants also acting as the gatekeepers (Crozier and Davies, 2007). Indeed, the very limited parental participation might lead one to speculate that some parents may not have received the invitation letter to participate in the first place. In hindsight, the invitation of students and their parents as participants in the study could have been incorporated into one letter. As students would require parental consent (by signature) to participate, using such an approach, the parents of all participating students would, at the very least, be aware that they themselves were also invited to participate. In addition, only five science teachers participated in the interviews, although they collectively taught just under half ($n=21$) of the 46 minority ethnic students in the study. In this case, the lack of parent and science teacher interviews in the study limited the analysis of family and teacher influences on students' science and career aspirations, which could have also been useful for contextualising what students said. Any data related to the home were restricted to student interviews. Building on the work of Archer *et al.* (2012), the potential exists for further research into the role of minority ethnic parents and the ways in which family practices and aspirations (or 'family habitus') shape students' science, career and educational aspirations.

While students in this study attended London schools, they were not equally recruited in each school with respect to their ethnic backgrounds. Most Indian students in the study were recruited from Cranberry, and many participants from

Bangladeshi backgrounds attended Everest. In fact, the majority of Chinese students were recruited from Chinese complementary schools, and only one student was recruited from Davidson (*see* Appendix 1). Only in Barton were students from all (but Chinese) minority ethnic backgrounds recruited. The generally limited range of minority ethnic groups from each participating school meant that the analysis of ethnic differences, such as in students' science views, could be challenged as simply reflecting the difference between students from these participating schools. In other words, differences in students' science views could have been influenced by the schools they attended rather than – or as well as – their ethnic backgrounds. However, while most Chinese students in the study attended Chinese complementary schools, they did in fact attend eight different secondary schools during the weekdays, where science is normally taught and experienced. In this case, the collective science views of Chinese students in the study should not be confused as the general views of students from a particular school as they attended a range of secondary schools. However, as these Chinese students were dispersed throughout London, it was deemed impractical to conduct science classroom observations in each of the eight secondary schools they attended. It was also unfortunate that the two Chinese students from Everest School (i.e. Anita and Harry) were not present during the period when classroom observations were carried out. Chinese students were the only ethnic group in the thesis with no data collected from science classroom observations, which is acknowledged to be a considerable omission.

Students in most of the participating schools held a range of views of science including those in Barton and Everest, as science views tended to vary by ethnic backgrounds and/or science achievement levels. Admittedly, most students in Cranberry were Indian and seemed to share similar views of science. Thus, the science views expressed by Indian students in the study could arguably reflect the views of students from Cranberry. However, the one 'non-Indian' student (Saif, 12, M, Pakistani) recruited from Cranberry appeared to possess 'lower' levels of science capital, science interest and science achievement compared to most other Indian students recruited from Cranberry. In this case, the analysis of ethnic differences remains credible for students recruited from Cranberry, since the minor difference in the science experiences of the one 'non-Indian' student recruited from Cranberry

could in fact challenge the assertion that the similar science views of Indian students simply reflects the views of Cranberry students, and not Indian students.

Some influences on students' science experiences, such as the significance of individual schools, science teachers and their pedagogies/practices, were beyond the scope of the study. For example, the influence of school cultures or ethos on students' experience of science and education was not explored in detail. Some schools may, just like the influence of the family, facilitate a particular environment towards learning and achievement. Similarly, individual science teachers may teach in particular ways that encourage (or not) students to engage, aspire and/or achieve with science. These factors, nonetheless, have been explored by other scholars (e.g. Beatty and Gerace, 2009; Carlone *et al.*, 2011; Osborne *et al.*, 2004; Tan and Calabrese Barton, 2010).

In relation to the research findings, there may be an issue of validity in relation to the classification of students with 'high', 'medium' and 'low' achievement, capital and interest in science, because these classifications were primarily based on self-reported data by students. Where available, science teacher interview, parent interview and classroom observation data were also used. The categorisation of students into 'high', 'medium' and 'low' science interest, for example, was mainly dependent on student interview data, during which students discussed what they liked and disliked about science. The level of science interest (e.g. as 'high', 'medium' and 'low') assigned to each student was ultimately determined by the researcher's relative interpretation of the data available.

Although no obvious differences existed between minority ethnic students and their science interest, such a marker separated the 'high' science achievers into those with extrinsic and intrinsic science interest, which informed the 'student science engagement' typology (e.g. *engagement without interest*). Similarly, science aspiration was understood to indicate whether or not students had expressed aspirations in science-related careers (which also informed the category for students with *engagement without aspiration* in science). However, the distinction between science-related and non-science-related careers was made by the researcher and may not reflect how students themselves viewed such careers as related to science or not.

Still, science career aspirations were expressed by minority ethnic students irrespective of their gender, class and ethnic backgrounds, which may be comforting for those concerned with science equity as, at least in terms of aspirations, science careers appeared plausible for minority ethnic students in the study, despite many recognising or constructing science as a field for ‘white men’ (*see* Chapter 7).

It is important to acknowledge that the classifications and markers mentioned above are by no means fixed, and they served as a useful way to differentiate students in relation to their achievement, aspirations, capital and interest in science. These classifications and markers ultimately informed the development of the ‘student science engagement’ typology, which distinguished seven discourses of science engagement amongst minority ethnic students in the study. These typologies were further explored through the concepts of capital (*see* Chapter 5), habitus and family discourses (*see* Chapter 6), and ‘science identity’ (*see* Chapters 7 and 8). Although the categorisation of students with ‘high’, ‘medium’ or ‘low’ science achievement, interest and capital were systematic, such process was nevertheless subjective and primarily based on student self-reported data. Future studies could test and refine the applicability of the ‘student science engagement’ typology with students from different backgrounds, such as groups based on differences in age, ethnicity and location.

Final remarks

This study focused on 11- to 14-year-old students, exploring the science and career aspirations of Black Caribbean, Bangladeshi, Pakistani, Indian and Chinese students. The ethnic patterns that have emerged – at least in terms of science achievement – appeared consistent with the minority ethnic ‘science education leaky pipeline’ (Elias *et al.*, 2006). Of greater concern, such differences appeared to exist even amongst 11- to 14-year-old students, with Black Caribbean and Bangladeshi students in the study populating the ‘lower’ ends and Indian and Chinese students dominating the ‘higher’ ends of the ‘student science engagement’ typology. Indeed, a closer look into the specific age or year group of participants did not reveal any pattern to suggest that students’ science views varied considerably within the participating age group.

Although existing research (e.g. Murphy and Begg, 2005) found that boys and girls hold positive views towards science at the end of their primary schooling (10 to 11 years old), future research could focus on minority ethnic primary schoolchildren and investigate the differences – if any – between their science experiences, examining the influences of their ethnic/family backgrounds in shaping their science engagement. The age at which some minority ethnic groups appear to disengage, or ‘leak’, from the science education pipeline is still unclear and thus, such research findings could be useful for policy-makers when addressing the early disengagements of minority ethnic students from science. Similarly, future research could also examine the notions of habitus, capital and family discourses in the context of minority ethnic students who study science at GCSE, A-level and higher education, incorporating the analyses of gender, class and ethnic inequalities and identities as minority ethnic students progress along the science education pipeline. Such studies would contribute towards addressing the gap in the science education literature concerning the experiences of minority ethnic students in science.

In this respect, the current study has sought to contribute to the small but growing understanding/knowledge base regarding how minority ethnic students experience, aspire and identify with science as part of their future pathways in the hope of more equality in science education beyond compulsory education.

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Appendix 1 – List of student participants for individual interview

School	Name	Age	Background information			More data
			Gender	Ethnicity	Social Class	Focus group /Observation
Barton	Amy	13	Female	Pakistani	Middle	Yes/Yes
	Fay	13	Female	Bangladeshi	Working	No/Yes
	Florence	12	Female	Pakistani	Working	Yes/No
	Gina	12	Female	Black Caribbean	Working	No/No
	JJ	12	Male	Black Caribbean	Working	Yes/Yes
	Jube	11	Male	Bangladeshi	Working	No/Yes
	Kelly	14	Female	Black Caribbean	Working	No/No
	Mani	12	Female	Pakistani	Working	Yes/Yes
	Norman	12	Male	Pakistani	Working	Yes/Yes
	Sarah	12	Female	Black Caribbean	Working	Yes/Yes
	Shane	11	Male	Black Caribbean	Middle	Yes/Yes
	Slifer	11	Male	Indian	Working	No/Yes
	Stacey	13	Female	Black Caribbean	Working	Yes/No
Cranberry	Andy	12	Male	Indian	Middle	Yes/No
	Becky	13	Female	Indian	Working	Yes/Yes
	Denise	11	Female	Indian	Working	No/No
	Jenny	13	Female	Indian	Working	Yes/Yes
	Joyce	13	Female	Indian	Middle	Yes/No
	Michael	12	Male	Indian	Working	Yes/No
	Ramos	12	Male	Indian	Middle	Yes/No
	Saif	12	Male	Pakistani	Working	Yes/No
	Samantha	13	Female	Indian	Working	Yes/Yes
	Vincy	13	Female	Indian	Working	Yes/Yes
Davidson	Rob	12	Male	Black Caribbean	Working	No/No
Everest	Amir	14	Male	Bangladeshi	Working	No/No
	Anita	13	Female	Chinese	Working	No/No
	Eric	14	Male	Bangladeshi	Working	No/No
	Harry	14	Male	Chinese	Working	No/No
	Kyle	14	Male	Bangladeshi	Working	No/No
	Ralph	13	Male	Bangladeshi	Working	No/No
	Ronnie	14	Male	Bangladeshi	Working	No/Yes
	Saiyef	14	Male	Bangladeshi	Working	No/Yes
	Stephen	14	Male	Black Caribbean	Working	No/No
	Tim	13	Male	Bangladeshi	Working	No/Yes
	Tony	14	Male	Black Caribbean	Working	No/No
Hakka	Donald	11	Male	Chinese	Working	No/No
	Gary	11	Male	Chinese	Working	No/No
Lancang	Matt	13	Male	Chinese	Working	No/No
	Tracey	12	Female	Chinese	Middle	No/No
Yangtze	Aaron	11	Male	Chinese	Working	No/No
	Dee	13	Male	Chinese	Working	No/No
	Gigi	11	Female	Chinese	Middle	No/No
	Hins	14	Male	Chinese	Middle	No/No
	Holly	12	Female	Chinese	Working	No/No
	Joanna	14	Female	Chinese	Working	No/No
	Mary	11	Female	Chinese	Working	No/No

Appendix 2 – List of student participants for focus group discussion

School	Name	Age	Gender	Ethnicity
Barton	Amy	13	Female	Pakistani
	Florence	12	Female	Pakistani
	Mani	12	Female	Pakistani
	Norman	12	Male	Pakistani
	Gina	12	Female	Black Caribbean
	JJ	12	Male	Black Caribbean
	<i>Kevin*</i>	<i>14</i>	<i>Male</i>	<i>Black Caribbean</i>
	Sarah	12	Female	Black Caribbean
	Shane	11	Male	Black Caribbean
Cranberry	Becky	13	Female	Indian
	Jenny	13	Female	Indian
	Joyce	13	Female	Indian
	Samantha	13	Female	Indian
	Vincy	13	Female	Indian
	Andy	12	Male	Indian
	Michael	12	Male	Indian
	Ramos	12	Male	Indian
	<i>Victor*</i>	<i>11</i>	<i>Male</i>	<i>Indian</i>
Lancang	<i>Alex*</i>	<i>14</i>	<i>Male</i>	<i>Chinese</i>
	<i>Celia*</i>	<i>14</i>	<i>Female</i>	<i>Chinese</i>
	<i>Chris*^</i>	<i>14</i>	<i>Male</i>	<i>Chinese</i>
	<i>Jane*</i>	<i>14</i>	<i>Female</i>	<i>Chinese</i>
	<i>Juliet*</i>	<i>14</i>	<i>Female</i>	<i>Chinese</i>
	<i>Odele*^</i>	<i>14</i>	<i>Female</i>	<i>Chinese</i>
	<i>Claudia*</i>	<i>13</i>	<i>Female</i>	<i>Chinese</i>
	<i>Selina*</i>	<i>14</i>	<i>Female</i>	<i>Chinese</i>
	<i>Steven*</i>	<i>12</i>	<i>Male</i>	<i>Chinese</i>
	<i>Simone*</i>	<i>14</i>	<i>Female</i>	<i>Chinese</i>

**These pupils only participated in focus group discussions; ^Chris went to an all-boys school and Odele went to an all-girls school, and both schools are also 'extremely' successful schools (e.g. with over 90% of its pupils attain GCSE with 5 A*-C).*

Appendix 3 – List of students who were observed in science classrooms

School	Name	Age	Gender	Ethnicity	Lessons observed
Barton	Amy	13	Female	Pakistani	2
	Fay	13	Female	Bangladeshi	4
	JJ**	12	Male	Black Caribbean	3
	Jube*	11	Male	Bangladeshi	2
	Mani	12	Female	Pakistani	2
	Norman	12	Male	Pakistani	2
	Sarah**	12	Female	Black Caribbean	3
	Shane*	11	Male	Black Caribbean	2
	Slifer	11	Male	Indian	3
Cranberry	Becky ⁺	13	Female	Indian	2
	Jenny ⁺	13	Female	Indian	2
	Samantha ⁺	13	Female	Indian	2
	Vincy ⁺	13	Female	Indian	2
Everest	Ronnie [^]	14	Male	Bangladeshi	2
	Saiyef [^]	14	Male	Bangladeshi	2
	Tim [^]	13	Male	Bangladeshi	2

Total of 22 hours of science classroom observations, with 16 minority ethnic pupils

** Jube and Shane from the same class*

***Sarah and JJ from the same class*

⁺Becky, Samantha, Vincy and Jenny from the same class

[^]Tim, Ronnie and Saiyef from the same class

Appendix 4 – List of science teacher participants

School	Name	Ethnicity	Associated student
Barton	Mr Carter	Black African	Norman
	Ms Smith	White Other	Amy, Jube, Mani, Shane
	Mr Tallman	White British	Fay, JJ, Sarah, Slifer
Cranberry	Mr Denzin	Black African	Becky, Jenny, Samantha, Vincy
Everest	Ms Strauss	White British	Amir, Anita, Kyle, Ralph, Ronnie, Saiyef, Stephen, Tim, Tony

Appendix 5 – Sample of information sheet and consent form (in recruiting pupil participants)

INFORMATION SHEET FOR PARENTS

December 2009

King's College Research Ethics Committee Ref: REP(EM)/08/09-67



Science and career aspirations: Investigating the views of 11-14 year old minority ethnic pupils, parents and teachers.

Dear Parent/Guardian,

I would like to invite your child to participate in a research project. Before you decide whether to give permission for your child to take part, it is important for you to understand why the research is being done and what participation will involve. Please take time to read the following information and if there is anything that is not clear or you would like more information on, my contact details are at the end of this information sheet.

Who am I and what am I doing?

My name is Billy Wong and I am a PhD researcher in the Education department at King's College London. I am interested in how young people and parents from minority ethnic backgrounds feel about science, education and future careers. I will be talking to minority ethnic young people, parents and teachers in the London area and would be very grateful if you would consider allowing your child to participate.

What will the benefits of the project be?

By taking part, your child will be making a valuable contribution to the knowledge of educational researchers and professionals. In particular, I hope the project will increase awareness of the views and experiences of minority ethnic young people in school science and their career ambitions.

What will participation involve?

If your child participates, he/she will be a) interviewed at school. The interview will take approximately 40 minutes. No preparation is required and your child is free to express any views or opinions he/she wishes, b) take part in a discussion group with other pupils and c) be observed in some of their science lessons. I will also be interviewing science teachers and parents separately about their views on the issues.

Participation is voluntary and your child does not have to answer any questions that they don't want to. You or your child have the right to withdraw from the study at any point and do not have to give a reason for doing so. The interview will be audio recorded, and later written up. All interviews will be treated as strictly confidential and will be fully anonymised. No one will be able to identify your child or their school. Data will be archived for use by other researchers only in anonymous form.

What do I do next?

If you are happy for your child to take part, please sign the enclosed consent form, and return the form to your child's schoolteacher. I will then arrange a suitable time with the school for the interview to take place.

Contact Details

If you have any questions you can contact me via email at billy.b.wong@kcl.ac.uk or my supervisor Professor Louise Archer, Department of Education and Professional Studies, Franklin-Wilkins Building, Waterloo Bridge Wing, King's College London, London SE1 9NH, Tel: 020 7848 3182, Email: louise.archer@kcl.ac.uk

PARENTAL CONSENT FORM

October 2009

King's College Research Ethics Committee Ref: *REP(EM)/08/09-67*



University of London

Science and career aspirations: Investigating the views of 11-14 year old minority ethnic pupils, parents and teachers.

- Thank you for considering taking part in this research. Please note that confidentiality and anonymity will be maintained and it will not be possible to identify your child from any publications. All audio recordings of interview will be deleted once it is transcribed into text form.
- I understand and agree to the participation procedure as outlined in the Information Sheet. Please note if you have any questions arising from the Information Sheet, please feel free to contact the researcher before you decide allowing your child to participate. You will be given a copy of this Consent Form to keep and refer to at any time.
- I understand that if I decide at any other time during the research that I no longer wish my child to participate in this project, I can notify the researcher and be withdrawn from it immediately without giving any reason. Furthermore, I understand that I will be able to withdraw data related to my child up to the point of publication (May 2011).
- I agree that the research team may use the interview data for future research and understand any personal data used would be in anonymous form.
- I understand that information related to my child will be treated in accordance with the terms of the Data Protection Act 1998. Please note that a No-fault compensation scheme is available to all participants.

Parental Consent:

I _____ agree that the research project named above has been explained to me to my satisfaction.

I agree to let my child: _____ to take part in the study. I have read both the notes written above and the Information Sheet about the project, and understand what the research study involves.

Parental Signature _____ Date _____

Appendix 6 – Pupil interview guideline

Background/Conversation opener

Can you tell me a little about yourself? /Can you tell me a little about your family?

Educational History

How did you end up coming to this school?

How/Why you came to this school?

School

General likes/dislikes

What do you think about this school?

Is there anything you like/dislike about going to this school?

What subjects do you like/dislike most in school?

Why is that? What do you like/dislike about it?

What kinds of activities do you like doing in school?

[For example, school clubs, societies or sports, school trips]

What do you like to do in your spare time? Do you have any hobbies or interests?

Achievement

How do you think you are getting on in your school work?

What kind of grades are you getting so far?

[Part2] Role of family and peers in schooling/aspirations

Are your parents happy with your progress in school?

Do you know what type of education your parents have?

Can you tell me what your parents do for a living?

Can you describe what they do at work? Wear what to work?

Do you know what type of jobs they were doing before?

How involved would you say are your parents in your school life?

(e.g. checking homework; parent-teacher associations)

Do they talk with your teachers often, or come into school regularly?

Why is that? Why not?

Do you know what your parents would like you to do in the future?

Why do they want to be that?

Have anyone in you family been to university before?

Are other parents similar to your family, do you think?

Where are your parents born? Where are you born?

Student aspiration

What about you, what ambitions do you have?

Did you have any idea what you wanted to be a few years ago (or when you were young)?

Why do you want to be that?

What do you need to reach that goal? How do you plan to achieve that?

Do you know anyone in that field? What is it about that you like?

What about your friends? Do they share any of your ambitions?

Do you know what kind of ambitions your friends have?

How do you get on with other pupils in school? How would your friends describe you?

[Part3] Science/Aspiration

What do you think of the science lessons in school?

How do you get on in your science lessons?

What do you like/dislike about it?

What kind of feedback are you getting from your science teacher? (such as homework)

Can you tell me what you have done so far in your science lessons?

What do you think? Anything you would like to learn more?

When have you the choice, what type of science would you like to take, or learn?

Do you do any science outside of school?

(Experiment kits, grow your own crystal, or clubs, Science Museum)

Do you watch any TV that is related to science?

(Brainiac, Dr. Who, Walking with Dinosaurs, Horizon, CSI)

How do you get along with the science teachers?

What do you think your science teachers expect of you?

How many GCSE sciences are you planning to take? Why?

Do you know anyone who really likes science stuff – like planets, planet, electronics, experiments, technology?

What about your friends, do any of them like science?

What do they like/dislike about science?

[Part4]

Identity – Views of any collective values/ dissemination?

If I ask you to imagine a scientist, what image do you have?

Can you describe the features and characteristics of the scientist in your mind? Where do you get the image of such scientist?

What type of people study science, or become a scientist?

Why do you think some people become scientists, and others do not?

Can you imagine yourself to be a scientist? Why/why not?

What about people similar to you, do they like science or study science?

What about your brothers/sisters/parents - do they like science?

What do your parents think of science?

Gender

‘Some people say that in the field of science, it is dominated by men, such that there are not a lot of women in science’: What is your view on that?

What do you think of female scientists?

‘Statistics seem to show that there are not many females in science’: What is your view on that?

Why do you think some people think that way?

Social Class

‘Some people say that science is for people who are rich or from a middle class background’: What is your view on that?

Can poor people become scientists?

What about you, would you say you are from a rich background, middle class, working class?

Ethnicity

‘I would consider myself of a Chinese ethnic background’: how would you describe your ethnicity?

‘Some people say that [ethnicity] people are lower/higher achievers’: What is your view on that?

‘Some people say that there are not many [ethnicity] people are scientists?’ What do you think?

Do you agree? Why do you think [ethnicity] people do not become scientists?

‘Some people say that there are lots of scientists who are white, and not a lot from ethnic minority backgrounds’: What is your view on that?

Why do you think some people think that way?

Can Black/Chinese people be a scientist? Is it more difficult?

Summary/Check list: Social class background; Ethnic background; Parental occupation; Parental education; Parental expectation; Aspirations; Science perceptions; Achievement

Appendix 7 – Teacher interview guideline

General background

Can you tell me a little about yourself?

How did you end up teaching here? How long have you been teaching?

Science in general

How do you think the pupils in this school are getting on in science (Key stage 3)?

How has that changed over the years?

What do you think are the challenges facing science teachers?

How has that changed over the years?

If I was a new science teacher, what advice would you give me?

Science students

What sort of pupils tends to do well in science?

(behaviour, quiet, clever, active, those who do homework?)

Is there like a particular group which tends to do better?

What about pupils that don't tend to do so well?

Why do you think some pupils do well and others don't?

What do you think some pupils are interested in science and others don't?

How do boys and girls generally do in science?

Are you aware of any gender differences in terms of their interest, engagement, or how well they do in science?

How different or similar are the boys and girls in general in your lessons?

Do you know any pupils that went on to study science at university, or became a scientist?

What were they like in school?

Can you imagine any pupil here that might end up taking a science career route? Why?

Minority ethnic groups

Do you have any idea about the expectations parents have regarding what they hope their children will do in the future?

Is that the same across all parents or what about ethnic minority parents?

From your experience, how do ethnic minority pupils generally do in science?

Have you taught any Chinese/Indian/Pakistani/Bangladeshi/Black Caribbean pupils?

What were they like?

How do they tend to get on in science?

Have you come across any particular issues regarding

Chinese/Indian/Pakistani/Bangladeshi/Black Caribbean pupils?

What do you think Chinese/Indian/Pakistani/Bangladeshi/Black Caribbean parents generally expect from their children?

What do you think?

From your experiences, what is the difference between pupils from different ethnic backgrounds?

Now, statistics show that ethnic minority pupils tend to be underrepresented in the field of science (at university and A-levels), what are your thoughts on this?

Individual pupil

How do you think [individual pupil] is getting on in science so far?

What do you expect from him/her in science?

How would you evaluate him/her?

Can you see him/her continuing science at A-level or further? Why/Why not?

Parent expectation/Typical student?

Appendix 8 – Focus group discussion guideline

Opening questions:

What do we think of this school?

Is there anything we particularly like?

Is there anything we particularly don't like?

Do we all agree?

What do we think of the teachers?

Focus on science

What about the science teachers?

How many science teachers are here/what are they like?

What about the science lessons?

What do we like about the science lessons?

What don't we like about the science lessons?

Do we all share the same view?

Anyone here likes science? Or wants to become a scientist?

What kinds of people do science? Or Study science?

Does anyone have a different view?

Role of the family/Parental expectation

You are all from similar ethnic backgrounds, I was wondering if you could tell me what kind of expectations do your parents have of you? What do they hope you to be?

Parents from my background, which is Chinese, tend to expect a lot from their children, what about your parents from [ethnicity]?

Why do you think they expect that?

What do we all think of their expectation?

Is it different from other parents do you think?

Are there any gender differences from parents? Are boys expected to do different things than girls? Do your parents expect the same for your brothers or sisters?

'I have been talking to other [ethnicity] pupils and they say that their parents are [XXX]' what do you all think? Are your parents similar?

Ethnicity

Are there any common jobs that people of [ethnicity] background tend to do?

Why is that? What might that be the case?

What other jobs would you say is typical?

Do we all share the same view? What other possibilities might there be?

'Some people say science is for people who are white, male and from a middle class background' – what do you all think?

(Probe gender, class and ethnicity)

Appendix 9 – Sample of science classroom observation fieldnotes

Fay classroom observation (Mr Tallman, Barton)

Nov. 5th 2010 - 8.50am - 9:50am, Year 9

Fay appears to talk a lot in the science classroom, though not loudly, she always seems to find time to ensure her appearance is of an acceptable standard. Fay was constantly checking her hair, and used mirror to check her light make-up, and even applying mascara and held a nail vanish at one point. Fay seem to invest in her feminine appearance, and such action during the classroom is supported by her tablemates, with two other girls with similar actions (using mascara and using mirror/face powder).

8.50am

As the pupils arrive in Mr Tallman's science classroom, they all pick up their A4 yellow jotters from the front desk (Mr Tallman's desk) before heading to their table and seats. Fay enters and is chewing (and continues to do so throughout the lesson). Fay sat at the front, with four other girls. She had purple head band on, supported by two further clips, with her back hair combed to one side. As the class settled, Mr Tallman counted '3-2-1' to quieten the class. Today is revision day and as Mr Tallman was giving out instructions Fay was talking to fellow tablemates as she checks her hair, looking left and right. Mr Tallman acknowledges Fay's table was talking (by calling out 'there's a chat going on at this table'), but continues to give instruction to the rest of the class.

9.05am

Two boys sat behind Fay's table were playing with the pens. As the class is meant to begin working in groups about the task set on the blackboard by Mr Tallman, Fay asked one of her tablemate about the status of her hair ('Is my hair alright?'), and continues to check hair as Mr Tallman and the rest of the class were asking for advice and help. The girl sitting next to Fay appears a little disengaged as well; with the other 3 girls at Fay's table resting their head on their hand, and writing at the same time. The girl next to Fay rubs her eye, appears to be tired. Fay has yet to look at the instructions on the blackboard. Mr Tallman hands out an information sheet to each table, regarding the future of scientific development, and picks on Fay to read it aloud to the class. Fay doesn't seem to know what she was asked to do because she was not paying attention to Mr Tallman (she was talking to her tablemates). Mr Tallman eventually chose someone else to read out. Fay was checking her hair once again as another girl in Fay's table was chosen to read the next paragraph. Fay giggles. Fay appears to be staring out of the window and the table at the back, mixture of 3 girls and 2 boys, seem very engaged to answer questions.

9.10am

Fay is seen to be checking her hair again, pulling her hair back with her fingers, as she finally looks at the blackboard. Fay's table continues to engage in quiet, casual conversation, as Mr Tallman was engaged with the table of interested students at the back. Mr Tallman then picks on another girl on Fay's table to read out another part of the information sheet. At one point Fay wanted to ask a question, with her hand half-rise, but as Mr Tallman was talking Fay return to writing down some notes. Fay appears to seek clarification with her tablemates about something, as she continued chewing and writing down notes. Upon a question raised by Mr Tallman, every table had someone with their hands up, with the exception of Fay's table.

9.15am

Fay's table continue to have casual conversation, and this time could be clarifications on the tasks assigned. The two boys behind Fay's table appear bored, and 'chopping' the pens on the table. Fay flicks her hair again, and shows some interest in the highlighter pen. Fay reached for a piece of folded A4 paper in her blazer pocket and gives it to the girl next to her, as she delivered a quick conversation – which is likely to be related to the content of the paper. Mr Tallman was talking about 'better body parts' and 'how to improve' as Fay's friend crumbles up the paper. Mr Tallman goes over to Fay's table afterwards and asks the

girls whether or not they understood the task they are supposed to do. A conversation in Fay's table was noted, apparently related to TV/Drama/Film, with the sentence 'He did rape her' (Fay), 'I've watched it' (Girl opposite), 'He's so cute' (Fay), 'the weakest link' picked up. Afterwards, the 3 other girls were writing, with heads down, and Fay and the girl next to her were talking, before picking up their pencils as Mr Tallman approaches.

9.20am

Mr Tallman asks the class for their feedbacks, and, as before, someone from each table, but Fay's, had their hands up. Mr Tallman had to calm the class down due to everyone shouting out various ideas (to improve the body scientifically). Fay's table did not particularly participate, looking at the blackboard at most. The group at the back were very engaged, consisted of 3 girls and 2 boys. Later, Fay's table split into two conversations, with one girl holding up a hand mirror to Fay. The same girl was then seen to be brushing her hair with a full-size hair brush. Mr Tallman was speaking to another group at the back of the class. The brush was put away whenever Mr Tallman approaches the group. Fay then walks over to her bag (all pupils bag were put to the side of the classroom), and takes the bag to her table, drawing out a hand mirror with a powder pad, as she checks her makeup. The other girls were talking as well as writing. Fay then asks the girl in the middle for something, using a spray hand-action. Fay continues to check makeup as Mr Tallman walks away from the table, and began applying lip gloss. Another girl, opposite Fay, was seen to be applying mascara. Fay passes her lip gloss to her friend next to her, who held it but did not use it. Fay continues to check her makeup with the hand mirror, and applies a few brushes to her face, as well as talking to the girls on the table. Fay frequently checks her makeup.

9.35am

One of the girls was also checking her face with a hand mirror, as Fay takes out a nail varnish of some sort. One of the boys behind Fay's table shouted 'stop using make-up', which caught the attention of Mr Tallman, who later went over to Fay's table and confiscated, and immediately binned the nail varnish. The same boy shouted 'ha ha'. Fay looked displeased but 'not bothered'. The rest of the class remained engaged in their activities and discussions. Fay and her table continue to talk, one girl continues to apply mascara, and another girl was checking the mirror. One of the boys from the table behind Fay's table walk to his bag, and upon his return, pokes the face of one of the girls in Fay's table, implying the amount of makeup (mocking her?). There was no reaction from the girl, so such 'teasing' may be regular. Fay's table is probably discussing makeup, with hand-action surrounding the face. Fay then applies mascara suspiciously, most probably after her nail varnish was disposed by Mr Tallman. Fay takes out the mirror again and applies further and then quickly passes to the girl in the middle – maybe it belongs to that girl. The other girls in her table were writing something, and Fay doesn't appear to write as much.

9.40am

The girl in the middle was seen to be applying eye-liner. Interestingly, when Mr Tallman ask Fay's table on how the human body could be improved scientifically, the table mentioned a 2nd eye-lid, which has the function of seeing things underwater. One of the boys at the back mocked this idea and said you can just use a goggle instead. One girl on Fay's table appears bored now, rocking on her stool – somewhat dangerously.

9.50am

Mr Tallman had to quieten the class as ideas spoken from a few tables. The lesson reaches an end as Mr Tallman indicates the tasks for next lesson. Fay was wearing trousers as to some of the girls who were wearing skirts.

Fay classroom observation (Mr Tallman, Barton)

Nov. 12th 2010 - 8.50am - 9:50am, Year 9.

Even the lesson was a mock exam; Fay can be seen as lacking focus and concentration, more so than the rest of her tablemates. She is often distracted and glances outside the window or at the wall. Her investment in her appearance is less apparent than last week due to the nature of the class exercise today, but again, she still managed to draw out a hand mirror to check her face – something which none of the other girls were spotted to do.

8.50am

Fay enters the classroom with a white, feathered-collar jacket, and the immediate conversation between some girls around the front table was surrounding Fay's jacket: 'that's a nice jacket' and 'big jacket' – which is acknowledged by Fay ('Yeah I know'). The girls continue to talk as more pupils arrive, creating a noisy moment as the class settles. Fay and the girl sitting to her last week was sitting on the stools already, both still with their jackets on, and were looking at a newspaper ('Metro') attentively, before Mr Tallman goes over to confiscate it, and binned it. Fay's hair was tied back, with the same purple clips and head band as last week. A girl shout out 'we're doing a test' – which was meant by expressions of 'cries' at the back table. Fay and the girls in the front table – which is only 3 instead of 5, as the two girls opposite Fay were sitting alone together at another table middle of the classroom – were warned by Mr Tallman to take off their jackets, 'last time, clothes off'. The rest of the class were still chatting.

9.00am

Fay is still chatting, as is the rest of the class, as Mr Tallman held a stack of papers, and began handing out some to each table, telling the pupils 'don't open up' Today the class is doing a mock exam, which is 30 minutes for one paper. Mr Tallman distributes two versions: a foundation and an advanced. The girl next to Fay's table still has her coat on, which is also white but much lighter style. Mr Tallman warned the class: 'zero communication', 'more formal' and 'under exam condition'. Fay and the class is quiet, as Mr Tallman gives out oral instruction in front of Fay's table, 'multiple choice', 'read the question properly', 'when there is a graph, the answer is almost always written on the graph'. Fay listens as Mr Tallman goes over to another pupil to answer a question. Fay and the two girls look at the blackboard, their papers and made some notes.

9.07am

The test began and Mr Tallman said it will end 9.38am. Fay looks at the board and begins to work. Fay called for Mr Tallman and he gives the girls another paper – probably the wrong paper (foundational or advanced) in the beginning. Fay continues, look down and it is silent in the room.

9.10am

Fay glances outside the window as some pupils walk by, and continue to stare as Fay's attention switched to another boy in the class who stick his hand up and quietly asked Mr Tallman a question. The rest of the class is silent as the exam is carried out under exam conditions. Fay looks down and continues to read and write, marking on the paper. Fay quickly glance the girl next to her, who had her head down, and continues to keep her own head down.

9.15am

One boy raises his hand, Matt, the training teacher, approaches, as Mr Tallman goes over to another boy who had his hand up. As the two teachers and pupils were answering their questions, a silent, whispering noise began emerging – which was done in a quiet and brief way. A visitor also appeared at the class entrance, holding a clipboard and appears to be assessing something. Mr Tallman approaches him and spoke very quickly with him. Fay glances but continues [Fay does not appear to be very engaged in the test as she seem to be easily distracted]. Fay glance outside the window as some other pupils walk by.

9.20am

The two other girls in Fay's table continue to have their heads down – presumably engaged in the exam. One girl (naming it 2nd girl) in Fay's table then held her hand up to ask a question. Fay looks and listens to the conversation exchange. The 3rd girl initially continued working as Mr Tallman was answering the question of the 2nd girl, but later also looked and listen. Fay joins in the 2nd girl's questions, and Mr Tallman continues to explain and answer their queries quietly. The girls held their heads down as Mr Tallman left and resumed working. Fay looks up, stretches a little and spoke a few words to the 2nd girl - who have since removed her coat.

9.25am

Fay looks up and glance the sky out of the window, and quickly scans the class. The girls then had a quick discussion with the 3rd girl holding up her paper and showed it to Fay, apparently confirming something. The 2nd girl then raised her hand, with the 3rd girl listening to Mr Tallman's response. Fay looks out the window where some other pupils walk pass, as she pulls her front hair back and continues to work with head down. The girls were also working, and Fay glances the 2nd and 3rd girl – with the 2nd head down and the 3rd stretching and looking at Mr Tallman – presumably in need to ask a question. Fay was looking at 3rd girl, who was looking for Mr Tallman. The class remain relatively silent – only disrupted by Mr Tallman, Matt (the training teacher) and the pupils who were asking questions in a whispering voice. The 2nd girl caught the attention of Mr Tallman and he gave the girls a quick word then walks off. The 3 girls appear disengage now, with Fay taking a sip from can of soft drink located at the centre of the table. Fay looks at the 3rd girl, and began a quiet conversation. 2nd girl was initially head down but soon joined in. The conversation continues and the volume of their conversation increases. Mr Tallman glances over and walks over, but did not say anything. Moments later, as the noise re-emerge Mr Tallman 'shhhh' the front table. The girls continue working as the 3rd girl stare blank at the blackboard. Fay was distracted by another girl coming into the classroom. A small conversation emerges in Fay's table as Mr Tallman was answering the question of another boy at the back table. Fay and the two girls were talking as Fay gave a smile to the 3rd girl. Just a note, the two girls who were studying at another table appear to be getting on fine, engaged, with head down most of the time.

9.30am

Fay glances outside again (2 seconds), and head down and continue to work. Fay glance her friend who had her head down. Fay started staring dully at the wall/window, for at least one minute. Her staring was broken by the 3rd girl, who initiated a conversation with Fay, and it was brief. The 3rd girl was resting her head on her hand now. Fay was picking her mouth with the pen and looked at the blackboard for at least 30 more seconds.

9.35am

Fay looks down on paper again, and looking over to the 2nd girl's paper. The 3rd girl goes over to her bag, walked a small circle and returned to her stool. Fay begins a conversation with the girls, while the rest of the class is quiet. Fay takes out a hand mirror, and checks her lips, and applying something to her lips. Mr Tallman appears to glance over to Fay's table but did not investigate further. The other 2 girls in Fay's table actually returned to work, with heads down. Fay then checks her work with the 2nd girl quickly, moving her own body position so that she can see better the paper of the 2nd girl. Fay stretches with her hands wide, and a brief conversation began once again. Fay looks outside and at the 3rd girl, as pockets of conversation began developing from every table. Mr Tallman 'shhhh' the class and said 'let's wind this down'

9.40am

Mr Tallman instructs the class on how to self-mark, stating he will first go over the 'foundations', before giving out the answers for the 'higher'. As Mr Tallman read out the answers for the multiple choice questions, some boys were excited in shouting out 'yes' – as a response to answering the question correctly. Fay's table were not making much noise, with each looking down on their paper, presumably marking it as Mr Tallman reads out the answers. Pupils of other tables were shouting out 'what' and 'yes' for each question. Fay's table showed little reaction, and continued marking on their papers. The table at the back is very excited. Mr Tallman move onto the 'higher' paper, and Fay's table were chatting quietly – presumably they did the foundation paper. One of the two girls who were sitting with Fay but not this week is doing the higher paper. I suspect, of the 20 pupils presence, around 6-8 were doing the higher (1/3). 2 girls (of 7) probably. Mr Tallman quickly went over the answers and there was no shouting or screaming of 'yes' or 'no' from any of these pupils.

9.45am

The marking is over and there was loud noises from the class, as pupils began packing up and some girls from the back went over to Fay's table, presumably enquiring their scores.

The girls at Fay's table were chatting as Mr Tallman has a quick word with the 3rd girl. Mr Tallman lectures the class on exam preparation as Fay flicks her hair cut, looks outside again, staring blank at the wall and the class is dismissed.

Shane and Jube classroom observation (Ms Smith, Barton)
Dec. 3rd 2011 - 13.50 – 14.50, Year 7

13.50

The class wait outside for Ms. Smith, with one or two boys playing 'physical' fight earlier. As the class enter some pupils rushed to the human body part apparatus that was near Ms. Smith's desk. It was a tool from last lesson. Shane and Jube exchanged few words, as Jube play fight with another boy. The topic this lesson is 'Combustion', as Geroge, the paper plane boy last time, play fight with Shane. Jube wanders around the classroom before poking the human body apparatus. Shane is exchanging words with another boy as Jube fetches his jotter and sat next to Sam at the back right table. Shane picks up his jotter and sat alone at the back left table, before talking to another boy, named Koffi, and then grabbing onto his blazer before being told off by Ms. Smith. Ms. Smith lectures Koffi for his argument with Shane, and demanded an apology from him to Shane, who was smiling cheekily. Koffi reluctantly apologies to Shane, but was later sent out for disgraceful attitude. Shane is sitting on his own, singing and looking out of the classroom window and at Koffi. Jube is copying from the board, in a table with Matt and Geroge. Sam moved to the front left table, where all other boys are sitting. There are 9 pupils today, all boys.

13.55

Shane continues to sing to himself and quickly exchanges word with Jube, who was sitting at the back right table (Shane sitting at back left). Jube shouts and complains that Shane is 'talking about my mum' as Ms. Smith intervenes and walks over to Shane, speaking to him, Shane partially ignores Ms. Smith as she is talking to him, singing to himself and to Jube. Jube continued copying, with Shane resting his head on the table, looking bored. Shane continued singing to himself, as the class is not too noisy. Koffi returns to the class but was quickly sent out again for constant talking. Jude and Shane exchanged a few words as Ms. Smith intervened. Jube tries to get George's attention.

14.00

Some pupils began calling out answers to a quick question and answer session by Ms. Smith, who walked over to a side board, listing keywords associated with 'burning'. Shane is leaning back, casually stretching. 'Don't shout' as Ms. Smith tried to calm some excited pupils. Jube and some others raised their hand to give some keywords, as Ms. Smith draw a spider diagram. Jube was engaged and responded 'tree', while Shane was resting his head on the table, doesn't appear to be that excited. Shane began knocking underneath his table, making some animal noises, before singing to himself in boredom. Ms. Smith attempt to 'shhh' the class (or at Shane) as Shane began drawing on the table. Other pupils were either calling out keywords or raising their hands. Jube is now copying the spider diagram from the board, as Ms. Smith returned to the board and her desk, giving information about the next slide. Shane makes screeching noises to draw attention, but was ignored by the class.

14.05

Shane is 'circling' his neck, like exercising, catching the attention of Jube, who smiled and laughed at something Shane implicated. Shane then hammers the desk like a drum set as Ms. Smith continued talking. Shane was seen to respond to Jube in a rather aggressive manner, 'are you talking about my mum?', before looking out of the window, standing on the leg-rest of the stool. Ms. Smith calls on Shane to 'stop talking' as Shane 'meowed' at Ms. Smith, claiming he doesn't understand. Ms. Smith responded maybe if he listens he may know more. Shane, for a moment, also mimicked the words of Ms. Smith, giving the impression of a disruptive student. Indeed, there were occasions when Shane speaks over Ms. Smith.

14.10

Ms. Smith is about to do some practical, demonstrating the burning of particular metals. Jube listens, and calling out answers like some of the boys. Jube was rather dramatic when

he got one question correctly. Shane continues singing to himself as Ms. Smith light up a wooden stick, about to set alight the Bunsen burner. Jube moves to the front right table, where the experiment is taking place, as are the rest of the class. Shane is playing with the socket switches at his table, not appearing interested, focused or engaged. Jube, on the other hand, appears excited. George approaches Shane and 'play' hit him, probably in response to something Shane said. Jube is engaged, calling out the keywords missing from Ms. Smith's informative lecture. Shane is looking away, fiddling the radiator and drawing on the table before joining the boys as Ms. Smith struggles to light the Bunsen burner. George pencil stabs Shane as Ms. Smith sends both of them back to their seat. Ms. Smith threatened to abandoned the experiment if they don't listen, and thus, the 7 other boys were anxious and all shouted at George and Shane to return to their seats. Under peer pressure, Shane reluctantly head back, looking displeased, and mouthing at George.

14.15

The other pupils surround the experimenting table. Shane waits on his table, standing and leaning forwards, watching. Ms. Smith finally lit the Bunsen burner, set at the safe mode of yellow flames. Shane complains loudly that George is not at his own table as he just sneaked to the main table. Ms. Smith acknowledges and tell George to return. Ms. Smith continued her demonstration, placing a metal under the flame. Shane and George again, briefly, played 'pencil' stabbing, as Shane mouthed at George, with Matt in between (both are now sitting nearer the experiment table).

14.20

Ms. Smith calls for attention as Shane continues to speak - to himself? Jube is sitting with the rest of the boys, surrounding the experiment table. Most boys are engaged as Ms. Smith burns some metal. Shane is complaining that he can't see, and argues with Matt. Jube remained engaged as Ms. Smith switches to the next metal. Shane is closer to the table now, watching as some pupils were excited by the 'firework' display as the metal was placed in a jar of oxygen. George watches at the main table, with Shane sitting behind Jube.

14.25

Ms. Smith continued onto the next metal as Jube talked briefly with George. Shane returned to his own table, standing as he asked and given permission to go to the toilet. Shane leaves. Jube is talking to Matt, asking him some questions – looking excited and engaged. Ms. Smith distributes a purple plate as the next metal will cause bright light that can damage the eyes. Ms. Smith needed to calm the exciting class. Jude is excited, waiting for what is to come, holding the purples plate in front of his eyes and quickly asking Matt some questions.

14.30

Ms. Smith continues as Jube wrote down some notes, before focusing his attention to Ms. Smith. For the next metal, the boys went 'wooo' as Ms. Smith burned some metal, giving off bright colour. 'Don't touch it' warned Ms. Smith as Jube is excited and continue writing down what he observed (which was meant to the task). Jube walked over to George, and copies his jotter apparently. Shane is not back yet, he missed few of the experiment already. Jube asked Ms. Smith a question about the consequence if more oxygen were added to the glass jar, which impressed Ms. Smith though she didn't give Jube a direct answer! Shane returns and slowly strode back to his table, ignoring the excitement of experiments and began writing on his jotter. Ms. Smith begins the next metal, as Shane continues not to pay much attention. Ms. Smith attempts to get Shane's attention, calling out, 'are you watching? cos I'm not doing it more than once'. Shane watches as Ms. Smith place the metal over the Bunsen burner. Everyone is engaged.

14.35

Shane began hitting his pen against the table, losing interest and humming to himself. Ms. Smith carries out the next item, asking Shane if he wants to come closer, who replied he is working on his jotter and will join afterwards. However, Shane seems happier on his own at the back table. Jube, at the front, is happy to wait (and write on his jotter) as Ms. Smith begins the next metal. Ms. Smith needed to calm and quieten the class as the next metal sparkled when placed in the glass jar. Shane appears to have lost interest, staring outside the

window before opening it, claiming the room stinks. Jube is focused, listening to what Ms. Smith have to say before exploding a series of questions for Matt about what ifs.

14.40

Shane asks how long to go before lesson finishes, with Ms. Smith indicating 10 minutes. Shane probably wants to leave. Jube continues asking Matt questions about oxygen, and appears very interested. Ms. Smith continues lecturing as she moves onto the next metal. Shane is still at his table, leaning, as Jube waits excitedly about the next metal. Shane looks bored and displeased, with all other pupils surrounding the experiment table (front right). Jube looking at the purple plate as one pupil called out 'this is boring', as there was no sparkles or fireworks with this metal.

14.45

In a short conversation between the boys and Ms. Smith, including Jube, who proclaimed she told him he got a 6 – presumably about grades in science, before Ms. Smith resumed to do the final experiment. Shane clearly lost interest by now, glancing outside the window even when the class responded 'wooo' to the next experiment. Jube stares at a glass jar filled with smoke, some pupils, including Jube, exaggerated coughs loudly in response to the smoke created. Shane was asked to open the window by Ms. Smith, and he did. Jube is leaning forward, engaged, as some pupils begin losing interest, playing the purple plates. Shane continued looking outside the window.

14.50

Ms. Smith tells the class to pack up, and told them to write down the observations they made before leaving. Shane packed very quickly, holding his bag and about to leave, but was sent back to complete his jotter by Ms. Smith, who waits on the door. Shane was not happy, claiming he has a dentist appointment. Shane moaned but returned to his desk and quickly scribbles something, before showing to Ms. Smith and left. Jube was in no rush, asking Matt further question as he writes on his jotter. Only 3 pupils left and Jube is one of them, still finalising his observations in a nicely drawn table. Jube checks his work with Ms. Smith and eventually leaves.

Appendix 10 - Typology of ‘student science engagement’: Gender, class and ethnicity

	Low Engagement	Wishful Engagement	Ideological Engagement	Medium Engagement	Engagement without aspiration	Engagement without interest	High Engagement
Total pupil	9	6	2	6	10	3	10
Boy	4	4	2	4	6	0	6
Girl	5	2	0	2	4	3	4
‘Working Class’	8	6	1	5	8	2	8
‘Middle Class’	1	0	1	1	2	1	2
Black Caribbean (Name-gender-class)	5 Gina-F-WC Kelly-F-WC Stacey-F-WC Stephen-M-WC Tony-M-WC	0	1 Shane-M-MC	1 Rob-M-WC	0	1 Sarah-F-WC	1 JJ-M-WC
Pakistani (Name-gender-class)	1 Amy-F-MC	1 Florence-F-WC	0	1 Saif-M-WC	1 Norman-M-WC	0	1 Mani-F-WC
Bangladeshi (Name-gender-class)	1 Tim-M-WC	4 Amir-M-WC Eric-M-WC Ralph-M-WC Saiyef-M-WC	1 Jube-M-WC	2 Kyle-M-WC Ronnie-M-WC	1 Fay-F-WC	0	0
Indian (Name-gender-class)	0	0	0	1 Jenny-F-WC	1 Slifer-M-WC	2 Joyce-F-MC Samantha-F-WC	6 Andy-M-MC Becky-F-WC Denise-F-WC Michael-M-WC Ramos-M-MC Vincy-F-WC
Chinese (Name-gender-class)	2 Anita-F-WC Harry-M-WC	1 Holly-F-WC	0	1 Gigi-F-MC	7 Aaron-M-WC Donald-M-WC Gary-M-WC Hins-M-MC Joanna-F-WC Mary-F-WC Tracey-F-MC	0	2 Dee-M-WC Matt-M-WC

Appendix 11 – Typology of ‘student science engagement’: Visual mapping

Science			Capital		
Achievement	Aspiration	Interest	Low	Medium	High
Low	No	Low	Stacey-BC		
		Medium	Anita-CHN Harry-CHN Stephen-BC	Kelly-BC	
		High			
	Yes	Low	Ralph-BNG	Amir-BNG	
		Medium	Eric-BNG Florence-PAK Holly-CHN		
		High	Saiyef-BNG		Jube-BNG Shane-BC
Medium	No	Low	Gina-BC Tony-BC	Amy-PAK Tim-BNG	
		Medium			
		High		Aaron-CHN Slifer-IND	
	Yes	Low		Joyce-IND Sarah-BC	
		Medium		Kyle-BNG Saif-PAK	Ronnie-BNG
		High		Rob- BC	JJ- BC
High	No	Low			
		Medium	Joanna-CHN Mary-CHN Norman- PAK	Donald-CHN	Fay- BANG Tracey- CHN
		High		Gary-CHN	Hins- CHN
	Yes	Low			Samantha-IND
		Medium		Gigi-CHN Jenny-IND	Becky-IND Dee-CHN Denise-IND Mani-PAK Matt-CHN Vincy-IND
		High			Andy-IND Michael-IND Ramos-IND

Low Engagement;

Wishful Engagement;

Ideological Engagement;

Medium Engagement;

Engagement without aspiration;

Engagement without interest;

Total Engagement

**Appendix 12 – Science achievement by gender, social class and ethnicity
(combined)**

Ethnicity	Achievement ‘type’	Working Class		Middle Class		Sub- Total	Total
		Male	Female	Male	Female		
Black Caribbean	Low	1	2	1	-	4	9
	Medium	3	2	-	-	5	
	High	-	-	-	-	-	
Pakistani	Low	-	1	-	-	1	5
	Medium	1	-	-	1	2	
	High	1	1	-	-	2	
Bangladeshi	Low	5	-	-	-	5	9
	Medium	3	-	-	-	3	
	High	-	1	-	-	1	
Indian	Low	-	-	-	-	-	10
	Medium	1	-	-	1	2	
	High	1	5	2	-	8	
Chinese	Low	1	2	-	-	3	13
	Medium	1	-	-	-	1	
	High	4	2	1	2	9	
Total		22	16	4	4	46	

**Appendix 13 – Science aspiration by gender, social class and ethnicity
(combined)**

Ethnicity	Gender	Class	Career aspirations		Sub-Total	Total
			Non-science related	Science- related		
Black Caribbean	Male	Working Middle	2 -	2 1	5	9
	Female	Working Middle	3 -	1 -	4	
Pakistani	Male	Working Middle	1 -	1 -	2	5
	Female	Working Middle	- 1	2 -	3	
Bangladeshi	Male	Working Middle	1 -	7 -	8	9
	Female	Working Middle	1 -	- -	1	
Indian	Male	Working Middle	1 -	1 2	4	10
	Female	Working Middle	- -	5 1	6	
Chinese	Male	Working Middle	4 1	2 -	7	13
	Female	Working Middle	3 1	1 1	6	
Total			19	27	46	

Appendix 14 – Cross-tabulation of students’ science interest with their career aspirations and with their science achievements

Science interest group	Career aspirations		Total
	Non-science-related	Science-related	
‘Low’	5	5	10
‘Medium’	10	14	24
‘High’	4	8	12
Total	19	27	46

Science interest group	Science achievement group			Total
	‘Low’	‘Medium’	‘High’	
‘Low’	3	6	1	10
‘Medium’	7	3	14	24
‘High’	3	4	5	12
Total	13	13	20	46

Appendix 15 - Sample of student interview data – with Amy, Fay, Hins, Ronnie and Samantha

Amy's interview transcript

Amy, 13, F, Pakistani, 'middle class', Barton school.

INT: Can you tell me a little bit about yourself?

AMY: I like Art, I like textile, I want to be a fashion designer, that's it...

INT: And how old are you again?

AMY: I'm 13...

INT: And you're year 9?

AMY: Uh-huh...you came into my science lesson this morning...you saw it was a big mess...absolutely horrible...

INT: You don't like it?

AMY: I don't like it...

INT: Ok...well, we'll move onto that that soon...can you tell me a little bit about your family then, like any brothers or sisters?

AMY: Ok, I got, erm, quite a big house, I live with my 2 brothers, my mum and my dad, and my grandmother, and my auntie and my uncle and their 4 girls!

INT: Oh, ok...so it's like two...

AMY: Yeah, it's really big family...

INT: Ok, do you live far from here?

AMY: I do...sort of, I live in *Velvet*...

INT: And how long does it take you to get here?

AMY: 45 minutes without traffic, yeah, with traffic it's more...

INT: Is that by bus or car?

AMY: Bus! By car it's like 15 minutes...

INT: Right, do your brothers or cousins attend this school as well?

AMY: Erm...my brothers in year 7 but he doesn't go to this school, he goes to *Stronghill School*...

INT: Oh, how come?

AMY: Cos he applied to this school but like he liked that school better...I applied for that school too but I never got in...So I got in here...

INT: So are you the only one?

AMY: Yeah I'm the only one here...

INT: Cos I was going to ask you how you end up in this school?

AMY: Oh well, my uncle, he came here like in 1994, yeah, it's not that long ago, like 14-15 years ago and he told my mum to look at *Barton* and my mum thought it was alright...

INT: What about you, what do you think?

AMY: I think it's alright...yeah...its ok...

INT: Anything you particularly like?

AMY: I like the art department cos I'm into art and drama...I like my English lessons, it's very good.

INT: Anything you don't like?

AMY: Science!

INT: Anything else?

AMY: Erm...

INT: Like school in general...

AMY: Erm...yeah, when it's raining we're not allowed to go inside and I kinda don't like that...

INT: You're NOT allowed to go inside when it's raining?

AMY: Yeah, not allowed to come inside, you have to be outside...like the sports hall got shelter, we have to like stand there...

INT: Ok, I see...apart from arts, what other subjects do you like?

AMY: I like loads of subjects...music, history...erm...loads of other ones, just in science we have more difficulties cos you saw the class it's out of control they don't listen to the teacher...when nobody's even trying listen to her good lesson...

INT: Do you listen?

AMY: Yes I do! Try to at least...

INT: Apart from science, any other subjects you don't quite like?

AMY: Hmm...Not really...erm, I don't know actually...I don't like quite PE, it's too much work!

INT: What is it about science you don't like?

AMY: The lesson plan, she has a good lesson plan but...when everyone comes in, there's too much talking, she can't calm the class down...and then, everyone will go even louder, into some, like, maybe, when a senior staff come in then everyone goes quiet...you saw that...

INT: So is the noise?

AMY: Yeah...

INT: What about the content, the stuff, the topics...

AMY: They're alright...but when...before we had our test, in our test...like some of the stuff in the test we didn't do before, yes, so, we have to revise before, because I realised in class, we didn't do as much as I read from the book...which was kinda like...[unclear]...

INT: Did you have the same class as last year?

AMY: No, last year I was in...cos there wasn't enough space in the middle set they had to put me in the bottom...and that was even horrible...

INT: That was last year?

AMY: Yeah, that was last year...it was even horrible, we did bookwork every single lesson and we did the same bookwork for the week, which was boring...you have to revise and revise...we have like a mini test every week and it was kinda...rubbish, cos everyone else wouldn't like get all the question right but apart from me and a few others, which was really boring cos we couldn't even be moved up...we have to stay down with the stupid ones...

INT: Hmm...In year 7...

AMY: In year 7, I was in the same classroom but not the same teacher, it was just my form...and we went through loads of teachers cos one teacher left and the other one came back....we had loads of supplies...I think we did...we did like really rubbish in our test, that's why we were all put in the bottom set...and then we got smarter in the bottom set but we never got to move up...

INT: Because...

AMY: Because the teachers erm, we had supply teachers for weeks and weeks...over like 5 months, which was really bad, but they couldn't do anything about it...cos the teacher left, she was pregnant and when she came back, for like the last few weeks of term, that was it really...we couldn't learn anything...cos everyone else was distracted...and when we had supply teachers everyone just took advantage of it...that's why...

INT: Did you enjoy science when you were in year 7 or year 8?

AMY: I sort of enjoy it...I like when we do like experiments and stuff, it's really cool...otherwise, not really...

INT: Ok, we'll come back on that later...erm, do you do any activities in the school?

AMY: Yeah I do art club, drama club...that's it [laughs]

INT: Have you been doing them since year 7, year 8?

AMY: Erm...I did drama club since I was in year 7, and art club's new, cos we have like a new teacher...

INT: Oh right, I see, do you go every week?

AMY: Yeah! Every week...

INT: Good good, what other stuff do you do in your spare school, outside school?

AMY: Erm...going on the computer, do stuff, watch TV and like, I like...I help my cousin with her coursework; she goes to a fashion college...

INT: Oh, ok, is your cousin older than you?

AMY: Yeah, she's older than me, I've got loads of older cousins...they all do business studies, becoming doctors...

INT: So your cousins are all older than you?

AMY: I've got loads of older one, and loads of younger ones, I'm kinda just sit the middle here...

INT: How is life in the middle?

AMY: It's ok actually, cos I'm not the only one...sitting there...cos I can get along with everyone...

INT: Yeah, I was going to ask how you get along with them!

AMY: Yeah...[laughs]

INT: Ok, how do you think you are getting on in your school work?

AMY: I think I'm getting on better...cos I had like problems in my class, with some people, students...we sorted it, and I'm doing really good now...on my tests also, just like, just knew everything and it was all coming to me...and I really...yes, I'm happy...

INT: Do you know what grades are you getting?

AMY: 6s...and yeah, I've got 6s in science and stuff...

INT: Oh, even in science, I thought you don't like it!

AMY: Yeah, I don't...it's just like, when we start, when we came, I had like 6 and then she put me on a 5...

INT: You mean your target?

AMY: Yeah, my target is a 5A and I got a 6C...so, but I don't know what I got in this recent test we did...yeah, I'm hoping a 6...

INT: So most of your subjects are on a 6?

AMY: Yeah...

INT: Are you happy with that?

AMY: Yeah!

INT: Maybe more?

AMY: Yeah I would like to, maybe in Maths and in English I can't, because I'm already in the top-set...so I can't go even higher, but in Maths, yeah, I would like to, cos I'm in the middle set...just to go to the top, to see what's it like!

INT: What about your parents, are they happy?

AMY: Yeah they are! They're not trying to push me, go in there or something like that, cos they know, erm, like when I was in primary school I was good at some subjects and in year 6 I learned a lot...and now I'm here, I've learnt...my progress had been faster and faster...

INT: So they're quite happy then?

AMY: Yeah, cos they thought like I'd be really slow at everything...like, I've proved them wrong...

INT: Do you know what type of education your parents have, like university...

AMY: They're got degrees yeah...

INT: Do you know what type of degrees?

AMY: My dad's I think it's on science! [Laughs]...I don't know why!...and my mum, I think, it's like Greek Mythology, yeah, I think she was into it when she was younger...but, hmm, she worked at Cambridge University, at the IT department where they marked the tests and stuff...

INT: And erm...does your mum does that now or?

AMY: No, she did that in the past, and now she's like a house mum...she helps my grandmother and my auntie, my auntie's got a little baby so she has to look after her and my grandmother is quite sick and she's disabled as well so my mum has to stay home and look after her...

INT: And what about your dad, what does he do?

AMY: My dad, he works...he used to work at Heathrow as erm, he still does sort of, he used to be in charge of like flights coming in and out, quite a big role...yeah, like 4 terminals...yeah...

INT: Do you know what he does now?

AMY: Erm...don't know what he does now...Oh...he's got his own car company...they get like drivers to drive people, like from posh areas to the city and back, to the airport...

INT: So it's still in the airport...

AMY: Yeah, sort of...cos he likes the airport...cos he used to work for...before that, American Airlines, and he used to get free tickets...in charge of how the flight works...it's like that...

INT: That's very interesting...do you want to be that?

AMY: No! [Laughs]...my dad was like, 'what do you want to be?' and I was like, 'into fashion', and he goes 'uhh', and cos me and my cousin, we're the same, going into the same route...

INT: Ok...erm, how involved would you say your parents are in your school work?

AMY: A lot...like, they help me so much...sometimes I don't need help they still give me it...cos they don't believe me, like, 'oh you're lying' [unclear]...they're doing this cos they want to push me, like, they want to push me but not too much, yeah, like, they help me a lot...

INT: In terms of homework...

AMY: Oh, homework, I do it myself, and then my mum checks it... and then she says, 'this one is wrong, do it again' and so I do it again...and then she'll check it again to see if it's right...

INT: So you do your homework...

AMY: Yeah, I just want to sit there, do it...cos I want to get it over and done with...any homework I got for next week I'd do it like tomorrow and then the weekend is free! That's what I'm like, I hate it when people wait till the last minute...

INT: I see, what about like parents evening and stuff, do they come a lot?

AMY: Yeah they do, on every single one, I know some people's parents don't come in, like they don't want to meet any of the teachers and stuff like that...I know one of my friends does, and...she's Indian, she lives in *Jackol*, she can't be bothered...she goes, 'I'll just sleep at home all day'...

INT: Ok...do your parents talk to the teachers often or?

AMY: My mum don't really phone in the school and say 'you're gonna push her' or 'can you help her out?' cos if I need help I will go the teacher and ask for extra work, that's it...

INT: And do you what your parents would like you to do in the future?

AMY: They want me to be whatever I want to be...so I'm actually allowed my own life!

INT: So when you told them about the fashion industry...they...

AMY: They said, 'it's your choice', they're quite happy actually...

INT: Cos you mentioned earlier that your dad was like 'uhh' when you told him...

AMY: Yeah, cos like, he's 'ohhh' and my mum's 'yay', my mum wants me to do art, cos I'm quite good at art...and, my auntie, she was actually an artist...yeah, and my grandmother, and now my grandmother's hand is old so she can't draw anymore...but, erm, she's had quite a few paintings, yeah, and my mum thinks I'm getting it from this side of the family, the hand and stuff like that, yeah!

INT: So do you learn from your auntie a lot, or ask her questions?

AMY: Actually when I was younger I just used to like drawing...first I wanted to be a doctor and then I realised I hate blood, cos one time I cut my arm and then 'ugghhh', that's it, don't like it, don't want to do it...and, erm, my auntie does cross-stitching and stuff like that and she teaches me, yeah, it was my auntie...

INT: What else does she do apart from painting?

AMY: Oh, she looks after her daughters...

INT: So painting was her main interest?

AMY: And drawing...

INT: What about your cousins and brothers? Are they into drawing as well?

AMY: My brothers are football and wrestling fans, my little brother and he is 7 years old and he goes, 'I want to have a subway shop when I'm older and have a wresting ring to myself' and I was like, 'yeah, go and do that!'...and then my other brother wants to go to erm, there's like Chelsea youth club training...and erm, it's Chelsea youth, Chelsea teams...erm, there's a college there and he goes, 'I want to go there', and my little cousins, they want to artist, one of them author, and, one of the other ones wants to be, like a cartoon, called Peppa Pig, and she wants to be Peppa Pig and I just start laughing cos it's so funny...

INT: Do you draw or do some artwork with your auntie?

AMY: I do artwork like every week just to get my...cos I do extra GCSEs even I'm in year 9...and, erm, I tell my auntie right I want to do this this this, can you help me?...so if we going to like the craft shop, we'll get there and she'll give me ideas and [unclear]....

INT: Do you think your parents are similar to other parents?

AMY: No...to other Asian parents, no, but to other parents, I'm not sure...but Asian parents, other Asian parents no...

INT: Can you expand?

AMY: Oh, alright, well, my parents are more laid back, don't mind, but other Asian parents are like really strict...they want their kids to be doctors, business people, accountants, stuff like that, they want them to go high, not interested in fashion or art...yeah, but my parents don't mind, and neither do my cousins parents, they...cos her friend, wants to do what she's doing [Amy's cousin?] but she, her parents force her to be a doctor so she's going to be a doctor, so yeah, my parents are more laid back than other parents...yeah...

INT: I remember last time [group discussion] you mentioned your parents were born here in England...

AMY: Yeah, they were born in England; their parents were born in Pakistan...

INT: And what about your auntie?

AMY: Yes, she's born in England, and her husband is born in England...all their parents were born in Pakistan yeah...

INT: Do you travel to Pakistan now and again?

AMY: No...last time I went was in 2005, and I think it was like the last time we're going to go cos my grandmother can't really travel...and really, I don't like going there, we catch like all different types of flu and it's really horrible...and, plus, it's not really a great place to be at the moment, with all the bombings and stuff, it's not safe...

INT: Ok...you mentioned you want to be an artist...

AMY: Fashion designer

INT: Fashion designer...

AMY: Into to arts!

INT: Erm...any specific areas within that field?

AMY: Well...I need art and tech and textile ones to do like interior and fashion design, that's more like my idea...my cousin's like, you know like Harrods, and what she do there, window display, she's doing that, designing like...different type of materials and dresses, and chairs...

INT: You also mentioned when you were younger you wanted to be a doctor?

AMY: Yeah...I can't believe I used to want to be a doctor!

INT: Where did you get the idea of wanting to be in the fashion industry?

AMY: When I was like 8, erm, I had like loads of magazines and I just like to look at them and stuff...and then, when I was 8 I got my first designer handbag from my auntie, [laughs], I started laughing cos I didn't know what it was and then, I, after that, like in year 6, I loved drawing...and we use to do like, every Friday, we have this time, called golden time, like, 2 hours, at the end of the day, just free you can do what you want, me and my friends just like stick materials together...and just really funny...I got it from magazines basically...

INT: And what do you think you will need to reach that goal of getting into the fashion industry?

AMY: Erm, I really need to concentrate on my art and textile and maybe on the computer...and, yeah, and also the languages, I want to learn...like if you go out of the country you need to know other languages as well...

INT: I forgot to ask; you mentioned your parents would like you to be whatever you want to be-

AMY: Yeah

INT: ...do they expect you to go to college and university?

AMY: Yeah, I'm definitely going to college and university, cos...I said to my mum when I was young that I don't want to be a slacker...don't want to stay at home...cos you see like teen mothers now it's really disgusting and I was like, to my friends, 'I'll never be one of

them', I'm sure I'm not, I'll go to like college and uni, get my degree, start my career off before I think about stuff like that [relationship/parenthood?], that's what my goal is...

INT: And do your parents expect you to go to university?

AMY: Yeah they definitely expect the same thing...

INT: What happens do you think if you go up to them and say I want to stop here, after secondary school? What do you think they will say?

AMY: I wouldn't say that, but if I did...erm...they would say like...I don't know...I don't know actually, I would never say that...

INT: [laughs]...what about if you say you don't want to go to university?

AMY: They would be quite upset cos they would like me to obviously get a degree...but I'm definitely going! [laughs]

INT: [laughs] Ok...what about your friends, do they share any of your ambitions to be in the fashion industry?

AMY: No...I don't know...my friends are like; they want to be lawyers and stuff like that...cos, and one of them wants to be an accountant...my uncle is an accountant...and they ask me about, like, you know how we have to go, like year 10, to work for a week...

INT: Work experience?

AMY: Yeah, experience and she was asking me about my uncle...and stuff like that...yeah

INT: Do you know anybody who is in the fashion industry?

AMY: Erm, not really, like, I mean, there are 2 boys who are really into art, but not many girls really...

INT: What about outside school, do you know any people?

AMY: Oh my god, so many people! My primary school friends, and loads of them are actually models, we were models when we were younger [laughs]

INT: Really!

AMY: Yeah, for Mothercare [laughs], like little babies...erm, but, my friend, she's a model for H&M, yeah, and, she wants to be a model when she's older, and she's not one of those skinny ones, but there's this other friend is like me, fashion designer and we share notes...and say, 'can you do this?' and 'can we do that?'...yeah...

INT: So those where your primary school friends?

AMY: Yeah

INT: Do you know any older people who are into fashion?

AMY: Yeah my cousin, and her friends, they're really nice, and really good at drawing...

INT: Do you talk to them often?

AMY: Yeah, like, what should I do with my idea and they'll give me plenty of ideas...

INT: Oh, very interesting...if I was to ask some of your friends to describe you, what do you think they might say?

AMY: Chatty...erm...I don't know...talkative...goes on about fashion stuff...like at this break, I was saying 'I want to wear this, I want to wear that'...and I like colour, like trying to make everyone colour coordinate...trying to make everyone with same outfit! [laughs], yeah, sort everything out!

INT: Ok...let's move onto the science bit now, what do you think of the science lessons in this school?

AMY: Erm...well...they're ok at times, and not ok...sometimes...like, I do quite like science...but...there's a downfall, you don't get to learn anything in the classroom, too much shouting, too much chat...just too much...

INT: So usually it's the other people who-

AMY: Sometimes...when there's like a supply teacher...it's worse, cos you don't know what the lesson plan is...they ask one of the students and they go crazy...

INT: Apart from the practical, which you mentioned you like, are there any other things you like about science?

AMY: I like doing practical...I do like learning...I...like chemicals and stuff, but we didn't get to do that cos someone dropped acid on the floor...and they set fire to it as well...

INT: Ok...is that in your class?

AMY: Yeah, happened last week, was so scary! Burnt!

INT: Can you tell me what you have been doing so far in your science lessons?

AMY: I don't know, we had test, and we did something today...on metals

INT: Do you remember what you did today?

AMY: It was on metals, and we watched a video and then, erm, we had to do like...erm, one of the metals add water equals something oxide...I written it down, can't quite remember it...

INT: Is there anything in your science lesson, like some particular topics, which you would like to know more about?

AMY: Not really!

INT: Ok...do you do any science outside of school, for example, like experience kits, telescope, grow your own crystals?

AMY: No...not really...but in school, you have your own make your own crystal I went to that it was quite cool...and like, rainbow maker...kinda cool, but that's it, the only thing I did in school, and that was like ages ago...

INT: Did those not excite you?

AMY: No, it didn't! [Laughs]

INT: No problem, what about television, do you watch any science related programmes?

AMY: There used to be this channel called Discovery Kids ages ago but that's not really sciencey, well, kind of...and...I used to watch that every single day...but erm, because we have more channels now my dad watches Sci-Fi and Discovery Channel...boring...like, I use to watch it but not really...Ohh, that's this one programme on Boomerang about science, like loads of kids making experiments...I watch that programme but that's it...

INT: Are those programmes fun or exciting?

AMY: Not really! [Laughs]

INT: Ok, how do you get along with the science teachers?

AMY: [Pause]...I don't get along with most of them...I get along with this one, this teacher [Ms Smith], but, sometimes I don't understand what she said [unclear] because of her strong accent...it's like...oh, the one downstairs, Mr. Cartier, I hate him...

INT: Why?

AMY: Oh, cos, he was the one I had at bottom set and he's the one that made me stay there...

INT: Oh...ok...I remember last time you mentioned how your parents came in and the science teacher said 'your daughter was stupid' and stuff...

AMY: Yeah...he said I was stupid! And my parents just don't listen to it...

INT: So it was Mr Cartier?

AMY: Yeah, and erm, and he said I was stupid, and I'm not actually, cos then he said afterwards at the next parents evening that, 'oh your daughter is meant to be in the top set but there's no space'...last time he said 'your daughter was stupid' and I don't understand!

INT: So how did your parents...

AMY: They said it but they don't listen...they know I'm quite good at science...cos they look at my book and stuff and I have loads of information I haven't used...loads of things...

INT: So, there's not much your parents could do after the science teacher told them you can't be in the top set because here was no space? Is that what happened or?

AMY: Yeah, there was no...completely no...erm...

INT: Did your parents say anything...

AMY: Well they said 'could you still move her' and they said 'no', and cos there was only a few weeks left so there was no point now in moving...

INT: So they just left it after that?

AMY: Yeah, just left it...

INT: Ok...no problem; do you know any friends who really like science?

AMY: No

INT: Ok...for the next part, if I ask you to imagine a scientist, what image to do have?

AMY: Erm...shocked hair...goggles...lab coat and probably like black powder everywhere [laughs]

INT: [laughs] where did you get that image from?

AMY: I watched a programme the other day...

INT: Do you remember what programme?

AMY: Yeah, Suite Life of Cody, and one of the guys like science and he was doing an experiment and he kinda blew it all up! And then Mr. Bean is another one, one of the episodes where he blew up something, turns the little kid blue!

INT: Ok...what type of people do you would like to become a scientist, or studies science?

AMY: People with glasses! Not all...some...I've not...like, seen any girls, and not many boys either...erm, I don't know, people in the middle?

INT: [laughs], ok...erm, what about yourself? Can you imagine yourself to be a scientist, or uses science in the future?

AMY: No!

INT: Why?

AMY: Because I don't like science...I could probably mess up the experiments...and probably get fired and I'd be like yay!

INT: Do you know what your family – your parents, brother, cousins – think of science?

AMY: My [younger] brother...he, over there, he had like completely different...it's a bigger school actually, bigger lab...bigger everything, yeah, and they got better plans and over there, I think, personally, it's better...than here, I mean he's learn more than I've learned in year 7...it's not that he's got 1 teacher but its cos, er, his class are quite good, that's why, otherwise, we would be good too...

INT: Hmm...what about your parents...

AMY: My dad likes science, my mum doesn't...she calls my dad a science nerd, that's why...

INT: Do you want to go to the same school as your younger brother?

AMY: I did...but like, I realised like, there's no point in moving, I've been here for 3 years so just trying to finish my secondary schooling here...it's better than going away...

INT: Ok...erm, moving onto the next part, now, some people say that the field of science is dominated by men, and not a lot of women are in science, what is your view on that?

AMY: That's true, there aren't a lot of women, I mean, I'm not like saying anything but most women would not like go into science...they...if they would, they would probably be like makeup artist, stuff like that, not that...like making makeup, but that's even men who make makeup...but, I don't get it, but there may be a few women but I do agree with that...

INT: Can you expand a little, why do you think there are not a lot of women in science?

AMY: I don't know, cos, most, from my point of view, I think maybe most of them are into...I think science is more man-ly-ish and most women would probably be like business women or into stuff like that, and shop...

INT: So women are interested in other stuff?

AMY: Yeah they definitely interested in other stuff...shopping, stuff like that...

INT: Ok...now some people say that science is dominated by people from a wealthy or middle class background, such that not a lot of poor people are in science, what do you think?

AMY: That's not true...hmm...my uncle knows this guy, he's was quite poor, from Pakistan, and when he came here over here he is apparently really wealthy doctor...really...wealthy doctor, he was from the slumps of Pakistan...and he...got everything, like degree, and everything and did another degree...and then, he works near Westminster so it's quite good yeah, so...that's wrong actually, so it's not really from a rich family you're always gonna do this...

INT: What kind of family background would you describe yourself, in terms of rich, poor, middle class, working class...

AMY: I don't know...not poor, not very rich, my friends say I'm rich but not really...probably...middle?

INT: Ok, no problem, now I would consider myself as from a Chinese ethnic background, how would you describe yours?

AMY: Don't know...Asian...yes, Pakistani...erm...some people don't think I'm from Pakistan like some people come up from the street going 'you're Brazilian, you're

Portuguese', and I'm like, 'sorry I don't speak Portuguese'...and, I get like told I'm from different places but if I had to I'd say I'm Pakistani and I have to explain to the person that, like, my parents were born here but their parents were from Pakistan... people don't believe me!...

INT: Yeah...erm, now some people say that people from a Pakistan ethnic origin, in Britain, young people in Britain, don't tend to do very well in education, or exams, such that they don't achieve a lot...what do you think?

AMY: That's quite a lie, cos I know quite a few Pakistani people that are not really rich, not really poor, middle class, that are actually top students and I think mostly younger Pakistani kids are brighter than other English kids, I'm not trying to be racist or anything...even if they were born here and their parents were born here, they're quite intelligent...my brother, my younger brother, he's quite intelligent for his age, he's like getting grades like my cousin, who is older than him...he was in year 2 and my cousin was in year 3 and he was getting like level 4s so he's getting good levels...

INT: Ok..erm, statistics have shown that there are not too many ethnic minorities in Britain who are scientist, or in science, why do you think that is the case?

AMY: I don't know, maybe like...maybe most Asians wants to be doctors, not scientists, cos erm, it's quite true but I think maybe others are not into science, that type of science, but other types...

INT: Some would say, for example, that there are not a lot of Pakistan ethnic origins...

AMY: That is true cos there are not many; because, erm, over there, they are a bit stupid...they don't know what they're doing half the time...

INT: What about those in Britain?

AMY: They know what they're doing...and there's quite a few whose got loads of degrees...they'll probably be like flying with better jobs...

INT: Ok...erm, some people that that as there are not a lot of ethnic minority people in science, there are lots of white people in science...what is your view on that?

AMY: There are, yeah...I think that's true, yeah, there are...because I think maybe more white people likes science, cos when you look at other jobs, like accountants, there're not all white, they're actually different coloured...like there are Asian ones...

INT: But in science?

AMY: In science, yeah...

INT: Why do you think in science it's mainly white?

AMY: I don't know...I don't get it...like maybe they're not into science, maybe they want to be maths or in English or something like that...like over here we got so many men scientist, but also I think that's wrong it's not all white people cos I'm not being racist but there are black people as well...yeah...scientist...

INT: Do you think it is harder, for example, for ethnic minorities in Britain to become a scientist?

AMY: Umm, I don't know, I'm not sure actually...yeah...

INT: What about, do you think, for ethnic minority young people in Britain; do you it is more difficult for them to do well in school, exams or to achieve? Or is it the same for everyone?

AMY: No...I think it's the same for everyone, unless their parents are pushy and wants them to be something else...

INT: So for every young people it's the same?

AMY: Yeah...

INT: Ok, is there anything you would like to add? About science, what you want to do in the future?

AMY: No...I don't think I'll need science

INT: What do you think you'll need then?

AMY: I think maths, languages, art, textile and IT...maybe a bit of English as well, I don't know...everything else is out of my way!

INT: I see...ok, let's end here...

Appendix 16 – Sample of teacher interview data – with Mr Tallman

Mr Tallman interview transcript

Mr. Tallman, 37, M, white English, Deputy head of years 7 and 8, Barton school.

INT: Can you tell me a little bit about yourself?

MR. TALLMAN: I'm 37 and been in teaching for 6 years, and before that I was in finance management and environment land base management so quite a departure...I went to uni quite late, at 24 cos I never really got school, one of the reasons I went into teaching was that I got fed up with work, in that environment to be honest, and school was such a poor environment back then I just, erm, thought I'd give myself a little bit back, so to speak...

INT: Why science?

MR. TALLMAN: I love science...

INT: Is that since you were young or?

MR. TALLMAN: Science...physics was always the subject in school I got on best with...erm, out of all of them...and it was just, when I started going through school I never understood maths, maths was a mystery to me so it didn't work out, school didn't quite work out for me cos how can you do physics without maths in many levels but at some point as I was growing up in work and so on something just clicked in my head and all of a sudden maths made sense, and all of the sudden all the stuff about physics just started flowing back to me and I finally understood it...so I was kinda a 'late boomer' academically...but erm, no, I've always loved science, everything about science, I just find it absolutely fascinating...

INT: So how did you end up in this school?

MR. TALLMAN: Luck...pure pure luck...erm, I was just about to leave my finance management post, I didn't really enjoy finance that much, I was kinda stuck in a dead end and erm, I basically sent out a letter to 50 schools, and one school replied and one school basically they said, they offered me a job as a secretary, and if that was the only job I could get at a school, at least that was something for me to see how schools operate...and I turned up, I interviewed, and one of the SOT [School of Thinking] members were interviewing me, *Ms. Edward*, and she turn round and said 'we don't want you as a secretary...you're carry on as a learning support assistant' so I did 2 terms of learning support assistant then all of a sudden I was teaching as an unqualified teacher for the term, and then all of a sudden I was on the GTP [Graduate Teacher Programme] training course...and here I am...and *Barton* school, it was, a very challenging environment, erm, the behaviours were all over the place, the results were not very good but it's one of those school if you learn how to teach in *Barton*, you can pretty much go and teach anywhere, but I kinda grew and absolutely respect this place in many respects because there is a character about it that I haven't seen in many other schools...and I'm sure there are other schools like Barton, but erm, I think some schools are technically better on paper but there is a spirit in this school that doesn't exist in others, amongst the others...they may all be very well behaved, they may all be very well liked, but the kids...you get really somewhere with the kids here and it really means something...you teach some of the kids in one of those schools and it's like, that's how they were brought up, it's everyday life, so you know, you do feel like you're making an impact, not just academically, but socially, something like this...

INT: Does it give you greater satisfaction?

MR. TALLMAN: Yeah, absolutely, I mean, every now and then I daydream about going to a better school but I never do because...

INT: And you are now, as I recall, head of year 7 and 8?

MR. TALLMAN: Deputy head of 7 and 9, erm, head of the STEMNET club, erm, and the head of all the online and internet resources and data as well...

INT: Erm...how do you think the pupils in general are getting on in Key Stage 3?

MR. TALLMAN: Erm...in general Key Stage 3 is doing ok...erm, year 7 is a little bit...I think we could be doing better with the year 7 at the moment, we're not losing them but I

just think, erm, we just need to be a little harsher, including myself...maybe that's just me but erm, I got a lot of really nice kids, kids with a lot of potentials...erm, it's just one of those things where I'm never gonna see it as good enough...would probably be more honest...I think socially, we've got a lot of social groups forming up...but, you know, then you also look at some of the kids being isolated socially as well, I can't remember the surname, but one of the kids in the you were observing, *Slifer*, his name was...quite socially isolated in the classroom...outside the classroom erm, he does have friends, although a small number of them, which is fine, there is nothing wrong with that but in the classroom he does tend to be isolated because of a lot of our kids have this 'anti-neek' thing...erm, which is a real shame...erm, they just don't want to be seen as being neeks, so you'll often find, and I don't think Slifer is really falling into this category, but he is close, when you get a kid who is academically very capable, and outside he has lots of friend, but in the classroom, and the same friends will not...interact with them in the same way at all because they don't want to be seen as neeks, even though they're friends may be a neek...

INT: Is that an urban term, neek?

MR. TALLMAN: Neek, geek, basically, just the new word basically...the kids call me a neek and I said 'no no no, I'm older than you that makes me a geek'.

INT: [Laughs]...how do you think the Key Stage 3 has changed over the years, or, during the 6 years you've been teaching?

MR. TALLMAN: I think a lot of it is down to the transition from Key Stage 2 to 3...Key Stage 2 transition to Key Stage 3 was basically poor...and they came in from primary school, and they basically got to sit down in carpets and have a lot of circle time and all that kinda stuff, and all of the sudden they sitting behind big giant desks, there're a teacher at the front, bang bang, 'you will learn, this is your book, you are responsible for that', and all of a sudden, they had all these extra responsibilities that they NEVER had at primary school...all of a sudden they're expected to be in charge of X, Y and Z...and the transition from one to the other was quite poor...I personally think...it's got a lot better I think, cos one thing we're done we shelter, as much as we can, the year 7, from the rest of the school when they come in, so we could basically train them to be way we want them to be trained, erm, as much as possible from the rest of the school which means bad habits other kids have aren't automatically passed down to the next year group, erm, and that actually does work quite well and we've tried other strategies in the past which I haven't been involved in the school to be honest but for example, in science, we got err...the change in the curriculum actually helped a lot...they have the talking groups, they have spend time together whereas before, if you're a lazy teacher, there'd always be some lazy teachers, erm, you could get away with, erm, basically sitting down and saying 'this is what you must learn, answer these questions, learn this, go away', of course, in the new curriculum you can't do that...so there's a lot...the transition in the curriculum is a lot nicer...

INT: So the curriculum has shaped...

MR. TALLMAN: The curriculum always shape transition and I think one of the biggest mistakes they've made when they shaped the Key Stage 3 curriculum was not taking into the transition from Key Stage 2 to 3, they only looked at the educational content and not at the social impact it would have...and now of course, it's all about how these pupil are going to be as all-rounded individuals and that's built into the curriculum...

INT: For science teachers, what do you think are the biggest challenges facing you?

MR. TALLMAN: Erm...for Key Stage 3, I would say the challenges aren't that great...erm, as far as interest in gin science is concern, but as they get older, and they start develop the interest, the class they want to take...and it's a compulsory subject, so they have no choice but to take it, and yet, they might have no interest in science, and that's a major issue because you've got to maintain their interest even though they might want to do art, or drama, or something like that...so it is, it is maintaining the interest all the way through the school is probably the biggest challenge...

INT: And what do science teachers do to try and maintain that interest?

MR. TALLMAN: Erm...well, there's various way...one is to stand away as much from the standard lesson format as you can...I'm afraid you recently have not seen great examples,

but like today, we were out in the field, we were just making coke bottle fountains, mentos in coke...erm, it's also the build up to things as well...if you know something is going to be good, why only do it in that lesson...like, tell them something fun is gonna happen, give them a weekend to think about it...they're gonna come back, they probably won't completely forgotten about it, but at the back of their heads, they'll be thinking, something exciting is gonna happen today...

INT: I was just wondering, do pupils like, in year 7, have a high interest in science, then year 8, dipping, and year 9, dip more...and then some pupils just completely switch off...

MR. TALLMAN: Yeah, you get very few students who completely switch off...erm, you do get students who switch off and don't want to do it...and I think the problem is you're grading them on potentials and not what they want to do...so, even though they have no interest in science and don't want to do it, if they are capable of getting a B, then that's what you got to get...it's kinda like a double-whammy...like if the kids are not remotely interested in the subject, he's gonna focus all his attention to this, and he's not remotely interested in getting the grades you said he's gonna get, therefore, but, he's not gonna put much effort in...he's gonna make sure he gets a C and nothing else.

INT: Are you aware of any materials developed by the various science organisations?

MR. TALLMAN: Some of the updates, from ASE (Association for Science Education), erm, they are one of my best used...this one [TAKES A PIECE OF A4 PAPER], for example, is for the year 10, who just sat their GCSE exams...all they want to do is go home, they don't want to work, and it took me about 15 minutes to settle them down and towards the end of the lesson, we done this activity...all about medicine testing, drugs testing, opinions on drugs testing, have you changed your mind after learning about these facts...this is the ASE, but it's their...it's called update.org, and yeah, UPD, they make all kind of stuff like this, I mean, it's absolutely fascinating, a lot of it is really good...erm, for the teaching that is more obscure, more difficult to teach stuff, they have a tonne of resources...they're my favourites as far as resources are concerned...

INT: Ok...moving on to the science pupils...what sort of pupils tends to do well in science?

MR. TALLMAN: It's a mix bag...because you get kids who are...the ones who ends up doing well are often the ones who are a little bit on the chatty side, to be honest, they tend to be the ones who are a little bit...just a bit more outgoing than the quiet ones, cos the quiet one are very good at learning knowledge, but they're not very good at understanding...because they don't communicate as well with their peers or teachers as the guys who are more outgoing, and to be honest with you, I'm surprised actually there are more girls who are good at science...and I think it has more to do, in respect to the fact that they tend to sit in their own, little tight group, where the boys tend to be more malleable, in respect to who they're actually conversing with...erm, and so, it's basically, to be honest, it's generally, it's those who are outgoing that tends to be the better students in the end, because they will understand more even if they know less...and that ultimately will get them higher marks on paper...it's where the A and A-stars come from, it's the understanding not the knowledge...

INT: So it's those who chat a little bit?

MR. TALLMAN: Yeah I think you have to let them chat a little bit, I mean, I look at the grade scores...I mean, one of the problem is that we grade from A-C, and in reality, what I could do, is that I could sit there and I could make sure my class get C grades right...fantastic...I'll get a tick by my name...and technically, as far as the government is concerned, I don't have to push them more beyond a C grade...erm...oops, quite frankly, looking at the grades spread, it's fascinating...because you do give the people who are capable of doing it the opportunity to do it as independent mans, erm, doesn't mean necessary learn by themselves, but it does mean leaning to their own learning, then they need other people to bounce off their learning off...and that shouldn't always be the teacher, that has to be others, therefore, they have to be able to bounce things around...so if you're not, if you're being quiet, then you're not gonna learn as much as the next person...

INT: Is there any groups which doesn't tend to do very well?

MR. TALLMAN: Always...there's a difference between having a bit of a chat and having a chat...erm, because there is chatting about the subject and what you're doing, you know, and moving around topics and stuff like that, I mean, I had a fantastic topic today with the year 9s, and they were talking about football and I came around and said 'come on, come on, get on with the task' and they said 'we are taking about the task' and I said, 'what are you talking about?' and they explained the task to me, from the point of view of football...so, it's...they were really pulling my leg a bit...because it was blatant that around half the time they haven't been talking about the topic, they had been talking about football...but it's because of the ways they do things they're able to make those sort of connections and lash things on...and you just let them do it, you let them lead that kind of thinking on...but the ones that's sort of like, 'ok, we got around 5 minutes to chat, so what did you do last night?', they never on topic...it's the group that never succeeds are the ones who bring the playground into the classroom, is the way I put it...they can't leave the playing in the playground...and they're the one who really really suffers the most cos even if you can get them to shut up and work, they'll still be thinking about the playground, and that's the mindset that's very hard to break..

INT: You mentioned that you were surprised that the girls did slightly better than the boys...

MR. TALLMAN: Well, I'm surprised they didn't do even better than the boys...erm, would be a more accurate statement because erm, all they have to do, realistically, for a lot of them, is to get out of that tight social grouping idea, and if you have, everything you will take to be better...you can easily get better grades by just doing that...erm, that is one of the problems with Barton as we're trying to keep everyone in tight little pockets so no one is interacting too much cos everyone's like trying to a peer something, trying to very lively and bubbly...so it's a very delicate balancing act, trying to get the girls to actually talk outside their group more but at the same time, try to stop everyone from just talking too much the same time, going off topic...

INT: Are you aware of any gender differences in terms of their interests, how well they do in science, or engagement with science?

MR. TALLMAN: Erm...girls tend to maintain, an apparent general level of interests throughout school and tends to be the boys that either go up in interest or great down in interests, so the girls is a much tighter erm, level of interest, disinterest, than the norm, but the boys tend to spread out a lot more on a scale...

INT: So a wider range?

MR. TALLMAN: A much wider range of interest, yeah...

INT: And how different or similar are the boys and girls in your lessons?

MR. TALLMAN: [Laughs] I would say it varies by age group, erm, year 7, they come in and they're all interested, erm, it's all new to them so they're interesting. By the time they're in year 8, you've already starting to see that broadthening of interest, it's already started...so, by the time...so it's a slow process, it's already happening, it does happen quite early on...in Barton anyway...erm, from what I gathered from other schools, not that unusual from other schools either...from what I gathered...

INT: Do you know any pupils that went on to study science at university or uses science for their career?

MR. TALLMAN: [shakes head]...No... [Laughs]...I've done a bit of a run of teaching the lower sets, so a lot of them were more interested in going into hairdressing, beauticians, mechanics, stuff like that, so the majority of the pupils which I'm seen at school were not generally people who were academically interested in the first place...they might be more interested in the hands-on stuff, erm, but I think that's just been my luck, with the classes I've got, to be honest with you...erm, we're doing triple science now and some of the classes I've been teaching now, some of them are interested in going into science and so on...but we'll see...

INT: Can you imagine any pupils right now that might end up taking a science career?

MR. TALLMAN: Erm...there is one, his name is *Abraham*, in year 11, erm, he's is gifted...he is very bright, he's a lot better at science I mean when we first started a lot of the

kids were like ‘oh what are you doing here?, why are you here?’ blah blah blah...they were really not very nice to him...

INT: Because he was very bright?

MR. TALLMAN: No, but he’s socially is not great and he’s speak, he’s speech is a quite distorted, he doesn’t sound quite intelligent but then he is consistently getting everything right so academically he’s very bright, and now, for example, he’s working in the gifted and talented groups, he’s working on an environment project for the school, and all by himself, he definitely is going to be a scientist when he grows up...

INT: I was just wondering, what’s he like in the classroom?

MR. TALLMAN: He’s well behaved but, now he is one of the boys...

INT: On the edge, becoming a neek?

MR. TALLMAN: He is a neek, I have no doubt about that...

INT: From the perspectives of other people, is he a neek?

MR. TALLMAN: Well, he’s in a class of neeks...

INT: Alright...so what is that like, do they talk to each other nicely?

MR. TALLMAN: Na...they’re horrible to each other...

INT: Ok, interesting...

MR. TALLMAN: Cos they’re the ones who are just very bright, and also very sporty and popular ones, they don’t want to see themselves as neeks, and they can be quite horrible to the ones who are neeks...and you get one, or two or three bright neeks who are just very nasty in general...like ‘ok, I don’t want to singled out by these guys, so therefore I’m going to be horrible to the rest of them’.

INT: So to maintain their popular and neek image?

MR. TALLMAN: So, yeah, but they don’t put forward the neek...thing...then you get the real neeks and you get the socially inept neeks, nerds, so everybody picks on them...it’s quite a tough environment...they can be very vicious to each other as well...

INT: What do they do?

MR. TALLMAN: It’s the insults, constant insults

INT: Verbal? Nothing physical?

MR. TALLMAN: No no no, verbal, nothing physical at all, erm, but it is verbal...lots of it...

INT: Is that in the classroom?

MR. TALLMAN: While in the classroom they’re more than happy to go for it...more than happy, right in front of me!

INT: How do you deal with it?

MR. TALLMAN: With this group, I know them for quite a long time so with this group, I just kick in on them...seriously and no one defeats me, I gotta tell you!

INT: Are you aware of any pupils, or any groups of pupils, that have like private tuitions or a lot of support from their parents?

MR. TALLMAN: Yeah yeah, there’s a few, erm, generally the top end of the school, key stage 4, tends to be more, but couple of the girls, one of the boys, yeah, erm, one of them have fulltime tuition. Girls tend to have more tuition...certainly more than the boys...

INT: And those who have tuition, do they have to do better or?

MR. TALLMAN: Erm...it’s erm...they tend to improve more...whether they end up getting a better grade is a different matter...because it tends to be, the reason they have tuition in the first place is that they are struggling, rather than to improve...

INT: I was just wondering, do you have any ideas about the expectations parents have on their children, regarding the future or education?

MR. TALLMAN: I can kick off on that straight away, I can tell you it’s often broken down by ethnic groups...erm...you’ve got the Asian parents, who are...so you got the...I don’t, East Asian parents, who are pushing behind the scenes...erm, you got the Asians parents who have high expectations of their children, and are more willing to talk to the teachers than the East Asian parents....erm, you’ve got the African parents, who tend to be ok, you get the Jamaican parents who can be nightmares, or, they can be useless...or they can be ok, it varies...but in general, the worse are the white parents, the white poor background parents, tends to be the least supportive parents...and obviously, that’s not 100% you know...you get

some from all walks of parks but yeah, it generally is broken down by ethnic and erm, how rich they rich quite frankly, the higher social scale, the more supportive their parents will be...

INT: Who are the East Asians, which groups would that include? I know the categories keep changing!

MR. TALLMAN: Sorry, I even confuse myself, so for example, China, Japan, Korea; I'll just call them East Asia! Cos I have no idea what to call them at all...

INT: From your experience, how do ethnic minorities generally get on in science?

MR. TALLMAN: I'd say the quietist tends to be erm, the more generally socially isolated...that's a whole worm pile that one...erm...the East Asian tends to be the socially isolated in the classroom, by choice, it looks like by choice, it's like, 'I'm here, and I'm here to work', erm...can you repeat the question again?

INT: How do ethnic minorities generally get on in science?

MR. TALLMAN: So you got the Asians do really well, the East Asians generally do well, erm, Jamaican generally do poorly, Africans varies quite a lot...erm...and, yep the Brazilian group, the South Americans generally do quite well as well...and the East Europeans are such a wide mix...we're got some excellent Polish pupils in this school and then you get some which is like 'oh my god, do you know what a pen is?' and they're like 'oh, I don't know I cannot understand' and then you catch them on the playing speaking perfect English with their friends! [laughs]...

INT: Have you taught any Chinese pupils before?

MR. TALLMAN: One...well, two...

INT: And what were they like?

MR. TALLMAN: Erm...good, well behaved...they basically applied themselves to work essentially, their work ethic were strong...erm, but as I said, the East Asian community tends to towards the insular, like 'I'm here, I'm ready, I'm now ready to work', so, less chatty, but there is something about them...they do a lot more work behind the scene...so while they are lacking that chatting about things in the classroom, they're doing it at home...

INT: You mean work or talking?

MR. TALLMAN: They don't talk very much in the classroom at all, which is what I often encourage but they don't do it in the classroom at all...but they go home and talk about it...and so they're still kinda getting the whole bouncing idea thing...but somewhere else...

INT: How do they tend to get on in science, from the two you taught?

MR. TALLMAN: Erm...well, generally, quite well...above average...

INT: And have you come across any particular issues regarding Chinese pupils?

MR. TALLMAN: Nope...

INT: What do you think Chinese parents generally expect from their children?

MR. TALLMAN: High expectations, stop!

INT: What do you think of that?

MR. TALLMAN: Fine! [Laugh]...I think its fine...I'm a teacher, so high expectation, great! [Laughs]

INT: Ok, what about Pakistani pupils, have you taught any?

MR. TALLMAN: Erm...quite a few, quite a few and it depends on whether they are male or female, the children...

INT: What's the difference?

MR. TALLMAN: It tends to be quite different...if I was talking to Pakistani parents about their male child, and the work of they're not doing, there is a, 'oh my goodness, something must be done about it', erm, now I get the same response when I talk about their female children but less will be done...there much less emphasis to actually get the female child to improve their work...so they do a lot more to the boys than they do with the girls...

INT: And how do Pakistani pupils generally get on in science?

MR. TALLMAN: Erm...again...I'd say above average, definitely above average...you do get some who just don't, that's gotta be said...so you do get this...the figures don't actually quite work when you look at them as to what the actuality is, cos you get quite a few who do

above average and you get a small minority who do really poorly and it drags the entire group down as an average so...

INT: How are they in the science lessons?

MR. TALLMAN: They're much more socially integrated in classroom [THAN CHINESE], definitely, much more willing to have a chat, mix in with other pupils...erm, girls tend to be the loudest, and hardest to control...erm, I don't know, I think it's partly to do with the lower expectations at home, therefore they feel they don't need to apply themselves in school possibility, that's my theory...

INT: [laughs]...ok, we'll move on to the Bangladeshi, have you taught any?

MR. TALLMAN: I've taught to very long time ago and I don't remember...

INT: The parents, any particular thoughts?

MR. TALLMAN: I didn't meet the parents at all, because they never turned up for anything, which in part answers part the questions...and the other I did met they seem very nice, but it was very early on in my career so I couldn't really tell you...

INT: And the Black Caribbean group, have you taught any?

MR. TALLMAN: Black Caribbean group...they tend to be quite loud, very chatty but they also seem to be the ones most affected by parents, you phone home and the next day they will come and meet us...but...there is a time limit, it's like a ticking bomb, at some point, they will just go off again and they will be back to their normal selves...so it's kinda like big cycle with them...where they'll be loud, chat a lot, get punished at home by their parents and then they'll be back again, get punished by their parents...it quite a cycle, a lot of them...

INT: Is there any difference between boys and girls?

MR. TALLMAN: Erm...I actually say the girls are...the Caribbean girls are a lot calmer...erm, and a lot more focused, a lot more focused than the boys are...

INT: And how do they tend to get on in science?

MR. TALLMAN: The boys not so great, the girls ok, but they tend not to be that interested in it...erm, when they get into Key Stage 4...so there's not much interest in science by the time they get to Key Stage 4 so it's very hard to say would they be good at science if they're interested in it...they probably would be but there's just doesn't seem to be that much interest among them...

INT: Have you come across any particular issues regarding Black Caribbean pupils?

MR. TALLMAN: Erm...racism towards African pupils is probably the biggest issue, and the other issue is the bravado factor, they tend to have a lot of face, like you can't be seen as taking their face away otherwise they just tend to explode and it's very much an ego thing, for a lot of them, very big on the egos for the Caribbean boys, but as I said, for the Caribbean girls, they are quite calm, generally well behave...but yeah, the Caribbean boys, very ego-based, so, you gotta be careful when you punish them shall we say!

INT: [laughs] Erm, what about Indian pupils?

MR. TALLMAN: Erm...Indian pupils, I taught quite a few of them...they tend to be quite well focused, but there's not that many of them that focus on science as their main subject in Barton, but the ones who are, seem to get on quite well...so...again, I'm gonna have to be a little vague on that one to be honest with you, because we have Indian pupils obviously erm, but, I haven't taught realistically a number of them in recent times...

INT: If you can summarise, how do ethnic minority pupils differ from each other?

MR. TALLMAN: Erm...quite of a lot of it seem to stem from parental backgrounds...and how they parents actually influence the pupils..erm, because, for example, you get the South Americans, parents tend to be on the balls, interested parents...you get the unconcerned parents which I will use as the non-ethnic minority...you look at the white boys...the parents, are generally, a lot of them, are very unconcerned...but you look at the other, all the other minority ethnic groups, the parents seem to play...a more involved role...

INT: Ok, we better move on, now, statistically, at the higher level such as university or A-level, ethnic minorities, most of them, tend to be underrepresented in the field of science....what are your thoughts on that?

MR. TALLMAN: Yeah...erm...I think in some cases you can see that as a natural progression through the school, certainly when you look at the Black Caribbean minorities, they...virtually every single one of them will drop out of science, certainly in Barton, and other teachers I know in other schools the chances of getting Black Caribbean to take up science to any great degree is virtually impossible...hmm, even if they're good at it they won't be interested in it...erm, you get other ethnic groups as well I mean it's interesting the mix you tend to get...erm, because it is...it is generally dominated by the better off white students, I don't necessary mean the more able students, I just mean the financially better off white students...but you also get middle eastern, they tend to dominate as well, but yeah, most of the other ethnic minorities tend to drop out of science...

INT: Any thoughts on why?

MR. TALLMAN: Erm...I've have many thoughts about this actually, because trying to get kids interested in science is a huge thing to be honest...

INT: But is it an issue of interest?

MR. TALLMAN: Erm...I think, I mean, there are a lot of issues...erm...I've have a lot of opportunities to talk to parents about what and there, there seem to be a lot of parental pressure about the route their child takes for one, and there is just a general lack of, sorry, another aspect seem to be the pupils' perception of it which also doesn't seem to necessary come from the school either, so, you've got this kinda double-whammy where you've got the parental approach which is basically 'we want you to succeed, we want you to succeed at something else'...

INT: But science?

MR. TALLMAN: Or you know, I mean, ok, maths is very important, English is very important, but unless you're going to become a scientist you don't need science...erm...which detracts from the whole thing...but you've also got the cultural aspects in which you actually talk to some of the children and it's 'I don't want to take science cos science is' we're coming back to that geek aspect again...'if I show that I am interested in this topic then I'm being seen to be geek' – they still don't seem to be able to get under their heads and even the parents don't seem to be able to get under their heads...it's a core subject they must do it and therefore choosing not to do it is not optional...but, the mind-frame turns it away, so you get the aspirational idea where you don't go into science to be aspirational...and you get another aspect which is the geek aspect, you know, 'I don't want to be seen as someone who wears a lab coat, glasses and god knows what else'...so, it's a tough one really, cos I think in many respects you can push it and make it as interesting as you can in school...erm...you can make a difference, but the difference is smaller than the engagement you have with the parents, for example...

INT: Ok...let's move onto individual pupils, what do you think of Fay, how does she get on?

MR. TALLMAN: She's ok...erm...it's a little early days to say which ways she swings at the moment to be honest with you, I would like to get her more interested...I've got to rearrange the class actually because erm, the girls sitting here are too busy bouncing off each other rather than bouncing the subject off each other if that makes sense...erm...so, she's doing ok, but she's doing ok because that's what she gotta do not necessary because inspired to do it...

INT: What do you expect from Fay in your science class...what grades do you expect?

MR. TALLMAN: Erm, she's an average student I mean, by the end of year 9 I expect a high 6...

INT: Can you see her continuing...into A-levels?

MR. TALLMAN: Erm...I'd like to see her...to be honest, I think she's one of those pupils we could hook onto...if she's treated properly...erm...that said, what I think and what I try to do in the early age isn't necessary what happens and so, I honestly think with something like her, I would probably fail in trying to get her interested in moving onto A-levels...but, she is one of the students I will try with! Erm, for example, I'm going slightly off track but the science club, the afterschool science club, everyone in year 7 and 8 has been invited multiple times throughout the year and yet, it is predominately white...

INT: Genders...

MR. TALLMAN: Genders generally make something slightly heavier on boys than girls but probably not as much as you think...but it's quite literally...white...

INT: Ok, what about JJ, your year 8?

MR. TALLMAN: Erm, he actually quite like science...erm, but, erm, he's not and he's never really shown a huge enthusiasm...I think verbally you'll often ask him he's like 'yes I would like to do x, y and z', erm, but you actually look at what he achieves or what he actually attempts, and, the words don't quite much to the efforts involved, so to speak, and that's been true all way through year 7 to 8...erm, if that changes...I think, yeah 9, realistically is gonna be the key year for JJ, not year 8, unfortunately, but I think year 9 we'll gonna see where he's gonna go, cos he definitely has the potential to go on to do something like triple science, if he decides to apply himself, and possibly even go on to do science at A-level and so on...erm, but at the moment, I would say, even if he wanted to he hasn't got the willpower yet, to actually drive that forward at the moment, he's quite interested in the art subjects as well, erm, but It's funny because again you get that kind of geek neek element, and he's not quite willing to admit to certain things and he's willing to admit to others...so if you trying to get the truth out of some of these kids it's just a nightmare!

INT: And what kind of grades are you expecting from JJ?

MR. TALLMAN: 6...yep, a 6, I don't know...

INT: Sarah...how is Sarah in the classroom?

MR. TALLMAN: Yeah...ok...I think...no...I don't think...she's will not go on to do science at all at high level in GCSE, she will certainly not be doing triple science at GCSE at all...erm...she does it, she learns it, but there's no great involvement, no great interest unfortunately...they never are!...

INT: And how is JJ in the classroom in generally would you say?

MR. TALLMAN: He's generally fine...he's quite a chatty boy...but he can direct that chatter into certain...productive chat...

INT: Like bouncing off each other?

MR. TALLMAN: Yeah he's very good at that kinda thing...erm, he can actually generate that kinda level of interest...erm, this is another reason why I need to move the seating plan around cos what you've seen [THE RESEARCHER] is quite a lot of groups where they're not working together properly...JJ is in a group where he might start off working but then dragged off task by the people sitting around him...so, the whole thing needs to be re-meshed, re-engaged...but erm...

INT: Sarah?

MR. TALLMAN: Sarah...just no...really...

INT: Ok..Slifer?

MR. TALLMAN: Slifer, he loves working by himself, he doesn't like working with other people at all, sitting with other people and he'll ask for an extra book or extra worksheet...or something, rather than actually being involved in a conversation. He's intelligent enough to be good...but...he's not...erm, he just hasn't yet got the social skills, that's fine at the moment, he needs to be pushed into groups...basically...

INT: So he is on the edge at the moment, of the socially isolated type?

MR. TALLMAN: Yep...he's usually socially isolated but by choice, erm, rather than design...so, for example, if you have JJ and Slifer sitting on the same table...[shakes head]

INT: Ok...have you met of their parents?

MR. TALLMAN: I was support to meet some of them but the majority of them actually never turned up! JJ's parent I have met, very nice, very supportive, so I get the impression that if JJ turn around and say 'this is what I want to do', then they'll support him in doing that, erm, and they're generally quite supportive of the school as well...erm, Sarah's parent, I've only had the opportunity to speak to, erm...they're not really what I would describe as pushy parents...

INT: Laid back?

MR. TALLMAN: Yeah...for a lot, I mean, you get a lot of bad parents, 'oh they did that did they...ok...thanks for letting me know'...and that's the end of it, there was nothing

else... 'did no work? Oh, I'll have a word with them' and they have a word with them... what do you do! You know, amazing, fantastic... so, that's why, that's another reason why I don't think Sarah will ever gonna be interested in the science subject...

INT: What about Slifer or Fay's parents?

MR. TALLMAN: Erm... I haven't, I just don't know Fay's parents... unfortunately, I should... erm... I haven't had a reason to talk to Slifer's parents, cos all the sociological engineering I could do I could do in the school without their help anyway... and Fay unfortunately is never one of those pupils that is up and up on the radar enough... she's one of the those students who kinda gets lost in the mist... so you gotta be very careful with those but erm, as far as contacting parents are concerned, they never turned up...

INT: Just wondering, what classes are they in, I notice there are like top sets and middle sets...

MR. TALLMAN: Fay is top set, JJ and Sarah are second set and Slifer is second set...

INT: So there is the top set once they begin... how do you... place them?

MR. TALLMAN: Erm, year 7 is allocated on reading and writing abilities when they entered the school, so it's not necessary based on subject proficiency.

INT: The entry test to the school?

MR. TALLMAN: Yeah and year 8 is suppose to be based more on their proficiency in the individual subjects... erm... I don't always necessary find this hideously accurate till they get to year 9... erm, so you generally get a lot of movement between 7, 8 and 9.

INT: It's interesting; I thought Fay's class was not top...

MR. TALLMAN: I have to be honest with you, it's absolutely bizarre... because they act like a bottom set group... and one of the problems is that no one bothered to tell them they are doing their GCSEs a year early, no one's actually sent a letter home or anything stuff like that...

INT: Do they know they are top set?

MR. TALLMAN: They knew they're top set... but no one ever told them that they're doing this... and basically I think this whole thing will take them out completely by surprise... and they still fight it cos some of them don't want to do it! They generally do not want to do it... some of them, genuinely have no interest in doing... but yet they've been forced to do it and they don't see why they should do it, so they get really... fractious, and some of them are terrified they gonna screw it up 'it's a year early!'

INT: I guess time is running out I better stop here!

Appendix 17 - Sample of parent interview data – with Narya

Narya interview transcript

Narya, 54, M, Father of Vincy, 'working class', Cranberry school.

INT: Can you tell me a little bit about yourself?

NARYA: Yeah, erm, my name is Narya and I'm from a Sikh family, erm, from India, we've been living here for the last 40 years, I came to this country in 1971, and erm, my whole family is here and I studied here for a couple of years and I found a job, as an electrician, at an electronic firm, I worked there. I got married and I got 2 kids now, erm, I'm happily married, yeah. I'm living with my mum at the moment; my mum is quite old, looking after her and that, yeah.

INT: Would you mind telling me your own educational background?

NARYA: I came in 1971 and I was around 14 and a half, yep, so I went to school for about a year and a half, erm, and then so, they told me to go to college for further education you know, so I was at college, learning English, and I've done a course, an electronic course, electrical yeah, and then, it was a 3 years course, then I found a job in an electric firm called Falcon, I worked there for 15 years, and, they closed down, so erm, then I found a job in a bus company, I start driving buses, and then now, I worked 10 years at Flying Airlines at the airport, yeah, I haven't actually done any proper education like you know, only done under 2 years study here before I chose the course.

INT: Can I ask what the occupation of your partner is?

NARYA: My Mrs?

INT: Yes yes

NARYA: She is a childminder here.

INT: Has she always been a childminder or?

NARYA: No no, she used to work for a firm, erm, an Indian firm called Bridge, a company, she used to work there, but yeah, when my daughter was born she was find, but the year after she was born, she had all these rashes and that, and she quite the job and she started looking after her and then she started learning the course, she went to a few courses for the childminder, so she started doing that.

INT: I see, if I ask you to associate your own social class background, what would you say? Like middle class, working class, or, some other classes?

NARYA: I'm a middle class.

INT: Ok, moving on to the next part now, can you tell me how Vincy ended up going to Cranberry school?

NARYA: Well, erm, she's doing fine, and then we actually applied for a Sikh college in Jacobs, because we don't there she couldn't get the place there, but we recommended a few other schools and this one was the nearer one, we got this place, she's quite happy, you know, very friendly, she's like it there, and now, she chose these subjects and she want to be going into pharmacy, err, she likes science and she wants to go into pharmacy in the future.

INT: And how would you say she is getting on academically?

NARYA: Yeah she's doing very good, because we get the reports, we go in and see the teachers as well, and they're very happy to have her, she's improving all the time, every year, and she's getting good grades, and we're quite happy you know, and we send her every Saturday for extra tuition, yeah.

INT: And what kind of tuition is she getting?

NARYA: She has maths and science one I think, yeah, science and maths.

INT: Was it your decision to send her there or was Vincy's decision wanting to go there?

NARYA: Yeah, because she wanted to get more and she's happy to go there, we're not forcing her, she wanted to go, and we are happy, if she's happy to do that.

INT: Are there any subjects you feel that it is particularly important for her to do well in?

NARYA: Yeah yeah, she's ok in maths, English and science...she's doing GCSE in P.E. and she's doing it earlier, and English as well, the English media.

INT: Do you have any concerns about how she is getting on in school? Or any issues with the school?

NARYA: Well, we're quite happy and because she's progressing every year, every term, erm, we're very happy and we don't have any problem regarding her, or any teachers, they always praise her, she's very good, a good student.

INT: Are you happy with the school in general?

NARYA: Well, it's very difficult to say now because she's halfway now, she'll be doing GCSE next year, so she's not trying to criticise now, she's quite happy and she got friends, she's quite happy.

INT: Ok, how would you describe your involvement in Vincy's education? Would you say you're a hands on parents, or a hands off parents or?

NARYA: We help her whenever we can, but my misses is more into it, you know, going to the evening classes and all that, as I do shift works, it's very hard for me to get a day off work sometimes you know, but she's more, you know, look after her interests, yeah.

INT: I see, do you, or your misses, go to the parents evening often?

NARYA: Yeah we do, she does more but once a year, I try to make it myself.

INT: I see, do you have contacts with the teachers quite often?

NARYA: Oh yeah yeah yeah, just checking if everything is fine, you know.

INT: And in terms of homework, do you help her often? Or do you monitor her homework or?

NARYA: I do check her homework when she done them, I had to sign the book you know, so I check and make sure she does it, and most of the time, it's been done, and if she got problem, she got her older brother, my son you know, he just finished uni, so he does help whenever he can, yeah.

INT: I see, do you encourage her to do any other activities, like afterschool or at weekends?

NARYA: Yeah yeah, she does the...twice a week she stays behind for the extra classes.

INT: Right, I see, moving on now, how would you describe Vincy? Her personality and how she gets on with her brother and people in general?

NARYA: Oh, she's very kind, very friendly, she mix up with others, and she helps her mum at the kitchen sometimes, you know, in the house, work, washing and stuff, she'll help her mum.

INT: What sort of things does she like to do in her spare time?

NARYA: She likes watching TV programmes or most of the time she's on the computer studying, yeah, and reading books and she's just play around sometimes with her brother, and on the computer.

INT: What would you say she, and as a family, would do on a typical weekend?

NARYA: Well, on Saturdays she got two hours, for the tuition, then she helps her mum with the shopping, yeah, I get, once a month, a weekend off, so I got different days off you know, like in the week as well, so, I do go sometime, but not regular, to the temple on Sundays, so it's quite like, as you say, England culture.

INT: I see, thinking ahead to education after Cranberry school, do you know what she intends to do?

NARYA: Yeah, she's passed all the exams and she's interested in science and the medical, I like to push her into the medical side, at the moment, she's very keen, yeah, very keen, I really, you know, I like to be her and doing what she really keen on it, I won't change her mind or something, no, I want her to do something different...

INT: I see, and how long do you expect her to continue in the education system?

NARYA: Oh as long as she wanted to do, you know, I want her to study for the full length you know when she can go to uni and finish her own education, and if it is medical it'd take more, like 4 or 5 years in the uni, so I wouldn't mind you know, I would fully support her, the family will support her.

INT: And do you have any particular hopes or aspirations for Vincy's future?

NARYA: I mean, every parent got a scope, that they should do well in their education, so every parent, like we do as well, so hopefully she will finish off her study and comes up with

good, erm, good grades and good education and I hope does well in uni, and her future like if she takes up medical and go to pharmacy and all that, hopefully she, erm, does well.

INT: And what do you think of the profession of pharmacy?

NARYA: I mean, I think it's quite good. She like it, very good job, and she's been, she suffered a lot because when she was young, her eczema, and I think that's why she decided to go, to help people, yeah.

INT: So do you know where she got this idea from, of wanting to become a pharmacist?

NARYA: Well, I think her cousin, erm, she's already done it, yeah, and she picked it up from him when they talk about it, and she's very keen in the beginning.

INT: So has it always be pharmacy or did Vincy aspired to be different things when she was younger?

NARYA: Yeah, I mean, I hope she does it, but if she can't then she probably go into education like teaching or something, yeah.

INT: Are there any particular jobs that you would like to see Vincy to do in the future?

NARYA: Well, I want her to do what she's planned, if she picked up one I'd be very happy for her, what she does as well, in pharmacy or in the medical field, so we'll be happy. We won't push her into something which she doesn't like it, so we'll support her.

INT: Would you like Vincy to follow in your footsteps?

NARYA: My footsteps? Well, I want her to do better, because I'm only a worker like, you know, so I want her to do her own thing, her own good, like, you know, I want her to do well, better than what I'm doing, I'm just like, I'm a controller what I do now, at the bus carriage, I'm a controller so I want her to be something, you know.

INT: I see, ok, moving onto the next part, in general would you say that you are interested in science?

NARYA: Well, erm, I'm not really...I can't really say, but erm, I can't really say much about myself and science.

INT: I see, do you watch any science or nature programmes on TV?

NARYA: Yeah, but, my son usually watch a lot of programmes on the TV regarding, you know, anything to do with the medical, he's quite keen and watch programmes like that. I just watch any kinds, because sometimes I work till late, so it's very hard for me to, you know...

INT: I was just wondering, if you remember, how was your own experience of science when you were in school?

NARYA: Hmm, I wasn't very keen or very good at it, to tell you the truth, I wasn't really yeah, but I was quite good on the electronic side you know, yeah, erm, specially finding something, to build something, physically, and finding something...

INT: Was science something interesting for you when you were younger?

NARYA: Yeah, it wasn't much you know, yeah, just an honest answer, I wasn't really...my study is like, halfway I came to this country, and I was in night class, yeah.

INT: Do you happen to know anybody who has a science-related job?

NARYA: Oh yeah yeah, it's very good subject, it's very good to have it, yeah, just very helpful to have it...you know.

INT: Ok, I see, would you say that Vincy is interested in science?

NARYA: Yeah, I think she is, she's very keen you know.

INT: Do you know how she is getting on in her science classes?

NARYA: She's doing really well you know, every time we talk to her teacher they're very keen, and now she stay behind and taking further lessons...

INT: Ok, moving onto the next part now, which is on perceptions of science, do you think there is a certain type of person who becomes a scientist?

NARYA: Well, it's a natural thing, I don't know, I can't really answer this, yeah, some person's very keen and some doing something in the future.

INT: Do you think working in a science-related field will suit the personality of Vincy?

NARYA: Oh yeah, definitely, she'd be much appreciated in the community.

INT: I see, now, my research is quite interested into understanding why not many young people today continue studying science after GCSE, in your opinion, why do you think many young people are not interested in science today?

NARYA: Erm, mainly I think the science is a very interesting subject, erm, but, err, you know, it's good for their future, so, if they are successful, they get well paid jobs, and will be very famous amongst their students, so I'm not quite sure why young people not are interested, to be honest.

INT: I see, do you think that being a boy or being a girl makes a difference to how young people perceive science, and whether or not it influence their interest in science?

NARYA: Well, I can't really answer that...

INT: Ok, because there is a lot of research which shows that science tends to be seen as a male dominated environment, I was just wondering whether you think it actually affects how young boys and girls see science as a field they could relate to.

NARYA: Could be, yeah, I can't really say, yeah.

INT: Ok, in your opinion, do you think a child's home background makes a difference to how likely young people are to study science in the future?

NARYA: Erm, well, in this school, in this country...I know people back home used to follow their parents in their jobs, in here, they're got a lot of different, erm, scope, lessons, ideas, and erm, they do their own...they like to do different, and erm, it's...I'm think it's better like, what the child wants to do, you now, not like, rather than you push them to do something, you want them to be successful, I mean, we will help her to do that.

INT: I see, ok, now, statistics have suggested that people from a more affluent background are more likely to end up working in a scientific field than people from less well-off backgrounds, so in your opinion, what do you think the reasons for this might be?

NARYA: I think she chose them, I mean, the medical, like I said before, erm, she suffered a lot on the eczema, I think she picked it up from there, so she, cos her cousin do, done the medical side, and she picked it up from that, and she, also, she's very interested...

INT: Ok, what is do you think of the idea that science is dominated by people from richer backgrounds?

NARYA: I can't really say, I don't know on that to best honest...

INT: Ok, finally, in terms of people from your own ethnic background, Indian background, do you think that science is a popular career route?

NARYA: Erm, yeah I could say yes, I feel the family, is got this medical thing...

INT: Do you have any idea why it is popular amongst Indian families in Britain?

NARYA: Erm, I can't really say, erm, it's just what people want to do...yeah...

INT: What do you think of the claim that science is dominated by people from a white ethnic background?

NARYA: Erm, I don't know really, I think it's what people want to do really, yeah.

INT: Ok, I think that's all I intend to ask today, do you have anything you wish to add with regards to what you think of science, or what your aspirations is for Vincy?

NARYA: No not really, just hope that she does well in the future, because she's very keen to work on this, and we're willing, the whole family, to support her, and erm, to help her achieve what she really wants to be.

INT: Ok then, thanks a lot, I will stop the recording now.

Appendix 18 - Sample of focus group discussion data – with Pakistani group

Pakistani focus group discussion transcript

With Amy, Florence, Mani and Norman, from Barton school, who were all individually interviewed.

INT: Let's start with some introductions I don't quite know your names, my name is Billy Wong or you can call me Mr. Wong, whichever you want, what about you?

[ROUND THE TABLE FROM MY LEFT TO RIGHT]

MANI: Mani

INT: And how old are you?

MANI: 12

FLORENCE: Florence, 12

AMY: Amy and I'm 13

NORMAN: Norman and I'm 12

INT: And do you guys know each other?

NORMAN: I know them two [Mani and Florence] from the start of year 7

MANI: Year I know you [Norman] from the start, you were asking people 'do you want to join the choir?'

NORMAN: Yeah [laughs]...[unclear]

INT: So you know these two [ASKING NORMAN, REFERING TO MANI and FLORENCE]

NORMAN: Yeah I don't know this one [REFERRING TO AMY]

MANI: I kinda knew her

INT: Ok, so you three [REFERRING TO MANI, FLORENCE and NORMAN] are year 8, and you [AMY] are year 9?

ALL: Yeah

INT: Oh good, we have some mix...we'll start with something general and easy, what do you think of this school?

MANI: It's alright but the thing I don't get yeah, they got money to build equipments and things like that, but do they have money to fix up the toilets...they stink, they need to have freshness in there

NORMAN: Exactly, there's cigarette all over the place, it's disgusting...with poos in the toilet...

ALL: [laughs]

NORMAN: The flush is broken, come on!...

MANI: It stinks...basically, the toilet should be like a robot, so you'll know if someone does something, so you can automatically flush it away

NORMAN: But our toilets still stinks...

INT: Ok...I guess that's the stuff you don't like, what about the stuff you do like?

NORMAN: Erm...a few teachers of some subjects...I hate my science teacher, that's the problem, cos I was at the top of the class, but now, I don't understand him, and when you try to correct them he gives you 10 minutes detention...if you pick up the glue stick he gives you 10 minutes detention...it's just some personal...

AMY: Is it when you get out of your seat he gives you 10 minute detention?

NORMAN: Yeah

AMY: I had him last year!

NORMAN: It was a glue stick I was trying to reach and he gave me 10 minute detention for no reason!

INT: Is it just you or everyone else?

NORMAN: No, he picks on me the most, he lets everyone go easy, and mostly me and the girls next to me, she's always shouting and he's scared of her...cos he gets embarrass when she tries to correct him and it does some stuff [unclear]...

INT: Do you guys have the same science teachers?

MANI: No, I've got Ms. Smith and I don't like her. I mean, I don't want to sit at the front table cos there's reasons and I told her to let me sit at the back and she's like 'no, sit where's your suppose to sit', and I told her the problem and she's like, 'I don't care, sit where your suppose to sit'...and I mean, like, I've requested like, nicely, 10,000 times and she's like, 'no , sit where your suppose to sit' and I was like, 'Ms...please'...so I swore at her and walked out, and I got in report for that!..I don't really care.

AMY: I've had both of these teachers, I've got Ms. Smith now and I've had Mr. Seabass...I don't really like Mr. Seabass cos he didn't teach anything...

NORMAN: Exactly

AMY: and we...all of the people in this class are all in the middle, but didn't really help cos can't understand anything cos he always shout, and then sometimes when I'm last in the classroom and he's told me to get out and then everyone gets 30 minutes detention for laughing, and if your smiling you get 10 minutes detention.

INT: Is that just you or everyone?

AMY: It was everyone

INT: And for you [Norman] is it just you?

NORMAN: No, basically in the first day he made everyone stay back for 10 minute cos some people just messed around, after finishing their work, cos he had no work set, and then after weeks, he just kept me and some other person, mostly me, and he says like 'oh you have half an hour detention for lunch time', for picking up glue stick, because it fell...and then all he does is shout...he just so stupid the way he teaches...and erm...I was like top set yeah, and I'm still top set but I want to move to the middle set or the bottom set because of his teaching... like he can't teach...any teacher can teach the top set yeah, that's the problem...should be qualified teachers who can teach and speak proper English...

INT: Hmm...what about yourself [REFERRING FLORENCE]?

FLORENCE: Mine is ok...like too strict.

INT: And who is your teacher?

FLORENCE: Mr. Dashwor

INT: Has anybody had that teacher before?

MANI: I really thank God I don't have him...I'm scared of him

NORMAN: Everyone is scared of him...he teaches good though

FLORENCE: Yeah

MANI: But the thing yeah, he's like a mad scientist...he's like, I was in his lesson once, my teacher was ill, he's like...you have to COMBINE THE MIXUTRES [WITH HAND GESTURES] and I was just looking at him and he's like...'yes, you got a problem' and I'm like 'no sir', and he was like, 'fine, get on with your work' and he shouted at me for no reason! So rude!

INT: Did you enjoy his lessons then? [REFERRING TO NORMAN]

NORMAN: No, we had him once, but he's a good teacher, but I think he is too strict...but I would prefer him more than Mr. Seabass because he can actually teach...

AMY: And he can speak English!

ALL: [Laughs]

INT: So is the problem lie with the English?

ALL: Yeah

MANI: And I don't like Ms. Smith yeah, and I want to be in the top set but I don't want to be in her lessons, and sometimes, yeah, I want help in these practical but I don't understand it, cos she talks really weird, yeah, she talks really fast, yeah, then really slow yeah, and fast, slow...then she's like [MIMICING VOICE] 'OK now we have to do that that that and this this this' and when we do the practical I was like, 'Ms...can I have some help please' and she doesn't even...she was like, 'you have to do this, and I was like, 'what do you have to do?...not just do this, what do you have to do? What's this?' and she goes off to some other people and helps them, and then I have to go up to her again, and she was like 'do what's on the board' but there was nothing on the board, so annoying...

INT: OK...erm...let's talk more about the science lessons then...is there anything we like?

NORMAN: Yeah I like the practical...but we only had once in 4 weeks time, cos we're suppose to have practical like 2 times a week, that's the rule of the school, but what happens is, say one person is bad and that makes the whole class...

MANI: Suffer

NORMAN: Yeah, by not making them do practical. Say...we're not doing practical, he makes us do test once a week, every week, [unclear], and he's like, that's what he expects top set to do, and I don't understand him and when I said something to him, he's like 'you get half an hour [DETENTION] for talking' and [unclear], cos I corrected him for some reason...cos he says 'tonnes' instead of 'turns'..that's the problem...

MANI: I'm not being rude yeah, but I once had him for IT and I was sitting with my friend in the middle yeah, and we were discussing something, and he was like, '5 minutes' [DETENTION], and I just looked at him, and he was like, '10 minutes', and I was like, 'what did I do?', and he was like, 'half an hour...sit at the front' and I was like, 'what did I do?', and then he said '45 detention' and I was like, 'no, I'm not coming, cos you have to tell me what did I do?' and he was like, [MIMICING IN DEEP VOICE] 'that's it, an hour detention and you're coming'. And I was like, I didn't go, cos I did nothing wrong, I was just discussing my work...

INT: OK...so what other things do you like about science?

MANI: Everything except the teachers!

NORMAN: Exactly I agree...

AMY: I like Ms. Smith but not really...just..erm...we don't do work and she just quits and walk out, and someone will stand there instead, then she comes back and walks out again...

MANI: [Laughs]

AMY: I think once she cried...

INT: What about you? [REFERING TO FLORENCE]

FLORENCE: It's ok...

MANI: Mr. Ashalaka, he's ok?

NORMAN: He's just [unclear]

FLORENCE: But he teaches properly...

INT: So you like the practical...but the teachers, does everyone think the same?

ALL: Yeah

INT: OK...interesting...

NORMAN: I would just like to add, when visitors come, yeah, he acts all nice...it's all an act

ALL: [Laughs]

AMY: That's so true...

NORMAN: Yeah, cos normally when I want to go to the toilet, he says, 'no' and he gives you 5 minute detention cos you didn't go at break time, but when a visitor is here he's like [MIMICING VOICE] 'yes, you can go go go' [Laughs]...and when if we do practical work, he say 'if you want to talk you ... put up your hand', but it's practical work yeah, you have to talk to corporate and he's like...so stupid...how he teaches...

INT: So anyone here thinks that science is something they would like to do or continue?

MANI: Yeah, you should, cos if you want to get higher grade, I like, see, I want to be a doctor and for me, being a doctor, you need to learn science, but I can't, with the teacher...the teacher, she's like...she's so annoying...with her in the room, you can't learn when she's actually in the room. When she's not in the room its kinda ok, some people are talking but some people are doing their work. When she comes in, right, 'you have to do this...right, the starter is...what's the complex of G2?'...what's G2? You need to tell us what's G2 then we can do the work, but no, 'you have to do this', what's the complex of G2?...so annoying...

NORMAN: [Light giggle]

MANI: [TO NORMAN] and it's not funny

NORMAN: It's just the teachers...they don't quite teach...

MANI: I think we should pick our own teachers

NORMAN: No, that can't quite happen, cos...but...they lost a lot of money because the Year 7 was small so they had to fire good teachers, and some teachers quit, so they're left with the rubbish ones...some good teachers left, like Ms. Alsareef in English...

MANI: Yeah she's good and Mr McBride

NORMAN: Yeah, good art teacher...yeah, they had to leave cos of the recession, and plus the year 7 was little so the government can't pay, pay little for them, only 75 children...so cutting teachers

INT: So, is the cut in teachers across the whole school or just in some departments?

NORMAN: Every department...in science we have Mr. Tallman, Dr. Phillips and Mr. Alexis...they're like the good teachers and the other science teachers aren't...and they can actually speak English and teach, but Mr. Windor he left..

ALL: [Laugh]

NORMAN: He can't teach, he's like from Africa...that's the problem...

MANI: They should get a translator yeah, where you can talk in the machine in some other languages yeah, any language, it will translate to you in PROPER English, yeah...it'll be better

NORMAN: I think, yeah...how can they get qualified if they can't even speak properly and if they want to teach the pupils need to know what to do....if they can't speak English....and they try to act and speak like English when a supervisor is there, and be so nice and no detention...but when they're gone, like, no supervisor there...you don't even want to be there, trust me...he thinks, like for respect, it's not a two-way thing but a one-way thing, but it's not...cos they have to give us respect for us to respect them, that's the problem...

AMY: Yeah...if they don't give us respect why should we give them respect?

NORMAN: That's the problem; they can give 100 detentions in one day

INT: Have everyone been in detention before?

NORMAN: Yeah I had 5 in one week, 10 times in 2 week but I never went to them...I said like I'm not going and he forgotten about it...

ALL: [Laughs]

INT: Is it just the science teachers or others teachers as well giving out detentions?

AMY: Mr. Seabass is a little crazy as well...

ALL: [Laughs]

AMY: I'm not joking...I walked into the class, like last year and it was like one of the last days of the term and he gave us a test even though we had an end of year test and he give everyone a 3As and said we're all crap and we're all thick and we started laughing...and he's like, 'get down to me [unclear]'

INT: And that was in your science lesson?

AMY: Yeah...that was science lesson, we did nothing....

NORMAN: You know, some people are scared of him...yeah, and if I'm late, like 5 minutes, he gives me like half an hour detention cos you're late, like 5 minutes, for half an hour!

MANI: The thing I don't like about the school yeah, is that all my friends elsewhere start school at 8:50 or 9 o'clock and here we start 8:30 and that's the time I wake up, it's so unfair! It should be like 9 o'clock...we need our space we need our time, we need time to get up! It's not fair!

INT: So you wanted to be doctor [TO MANI]...what about the rest of you?

MANI: Or a teacher...or astronaut...erm, actually not an astronaut!

INT: [LOOKS TO FLORENCE]

FLORENCE: Teacher

INT: What kind of teacher?

FLORENCE: I don't know

MANI: But a primary school one

FLORENCE: Yeah...

MANI: Secondary school students are too feisty!

ALL: [Laughs]

INT: [LOOKS TO AMY]

AMY: Like...the fashion industry...designing...

MANI: oooooohh

INT: [LOOKS TO NORMAN]

NORMAN: I don't really know cos it's not the time to chose yet...we don't chose our subjects yet but we're learning about Muslim, English, Science and Maths...

MANI: Professor!

NORMAN: [Laughs] [Unclear – referring something about imagery of science; blown up hair?]....there is just one science teacher that I hate is Mr. Cartier, he can't even teach one single thing...he can't even teach the alphabet..That's how stupid he is!

ALL: [laughs]

NORMAN: I think you [THE RESEARCHER] should speak to the headmaster...cos you're probably like university...

AMY: Cos they don't listen to us...

NORMAN: Ms Crubb is actually nice you know

INT: So which science teacher is the best?

AMY: Mr Phillip I think

AMY: Mr Phillip

NORMAN: Have you ever had him [TO FLORENCE]?

MANI: Mr Tallman

FLORENCE: My sister had him

NORMAN: So you don't [TO FLORENCE] have experience with him then don't say that

FLORENCE: My sister has...

NORMAN: Mr Tallman is like nice at the start of the year, and then

MANI: He gets really feisty...

NORMAN: No, he gets frustrated and gives you detention out of the classroom...so basically, Mr Phillips or Mr. Alexis...but the thing I like science is the volcano and stuff, rocks....geography is more advanced in science.

INT: OK...from your perspectives...what kind of people studies science do you think, or will become scientists?

MANI: The neeky people...

INT: The?

MANI: The geeky people

AMY: Do you [TO RESEARCHER] study science?

INT: No

MANI: The people that are geeky...who tuck in their shirt and ties...[unclear]

NORMAN: [Laughs]...I think to do science you have to be really clever...they have to learn stuff like Sir Isaac Newton...like how he create like laws and stuff, someone adventurous...and use technological stuff like that...

AMY: See people who make bombs, do they use science?

INT: Yeah...

NORMAN: Like nuclear bombs...they use science

MANI: Why do they learn science then!

NORMAN: Cos they can make advances and stuff like that...

MANI: Yeah to make bombs and people can die...

INT: So...erm...science is for clever people...geeky people....

NORMAN: I think it's geeky people that does science...

INT: What's the difference between clever and geeky?

MANI: Well, clever is just like...not geeky people, clever people are like 'yes miss, yes miss' but...

NORMAN: Geeky people are like teacher's pet, like know everything...clever people, like, they do like science and maths, and get good jobs and qualifications...[unclear][laughs]...I'm trying to move to a lower set to get a better teacher!

ALL: [Laughs]

NORMAN: It's true!

MANI: Move to my tutor! ...are we talking anything other than science?

INT: Well, this discussion is about science but we are moving onto something slightly different, erm, you might realise the composition of this group are from similar backgrounds, ethnic grounds...

AMY: [TO NORMAN] where are you from?

NORMAN: Pakistan!

AMY: You? [TO MANI AND FLORENCE]

MANI: Pakistan

FLORENCE: Pakistan

NORMAN: Where are you from? [TO AMY]

AMY: Pakistan! [Laughs]

ALL: [Laughs]

INT: So I was just wondering what kind of expectations does your parents have of you?

MANI: Geeky! Put your hand up to answer questions! Every question put your hand up

AMY: Yeah

MANI: You need to know the answer!

NORMAN: Basically...This is our view of Pakistani parents...what they want you to do is to be top of your class...my dad was like...when I was young he made me do spelling when I was like three!

ALL: [Laughs]

NORMAN: Yeah...our parents want us to get like A star, if we get like a B, they'll be like go away! They want us to get high grade so we can achieve something in life...like, they come from a poor, third world country, so they have achieved nothing and so they want us to achieve something more...

AMY: My parents were born here...

NORMAN: My parents were born in Pakistani

MANI: How are you Pakistani? [TO AMY]

AMY: My parents' parent were born in Pakistan...

ALL: [Unclear – all talking]

AMY: No, my parents were born here but their parents were born in Pakistan

ALL: [Laughs]

INT: Ok...so do all of your parents expect you to achieve highly?

MANI: My mum wants me to be a geek yeah, I went home, yeah, with my tie undone and she was like, she wouldn't let me in the house, she said [MIMICING] 'do your tie on properly, do your top button, tuck your shirt in, wear your blazer properly' and I was like, 'mum, I'm not going to school, I'm coming home!'

ALL: [Laughs]

MANI: Yeah, it's like she wants me to be a proper geek and as soon as I get home, my mum was like, 'have you done your homework?' and I was like, 'mum I just got home', and she's like, it's 8 o'clock, 'go to bed!', and I was like, 'mum, it's 8 o'clock' and my bedtime is like at 11, why do want to go to bed at 8!', I mean, it's so unfair, why do we have to be geeks?, we should be able to decide if we want to be a geeks or not...it's not fair!

INT: What about you [TO AMY]?

AMY: Because my mum and dad are graduates, they want me to graduate too as well...cos, when last year, I was at the bottom set of science yeah, and then my dad came to see Mr. Seabass and said 'I think she should be move up', but Mr. Seabass goes to my dad and said 'I think your daughter is really stupid, ok thank you bye bye' and then we just walk...I think Mr. Seabass really hated me...

MANI: [Giggles]

AMY: He hates everyone...yeah

INT: What about you [TO FLORENCE]...what do your parents hope from you?

FLORENCE: Just want me to be something when I grow up...

ALL: [Laughs]

INT: Does your parents like expect you to go to university and do into a certain occupation?

MANI: Yeah my mum wants me to go to Oxford University...

NORMAN: Yeah, I want to go to Oxford University because I heard it's good and my parents is like you have to finish university to get good qualification...and they...they don't care about how I look and stuff [unclear], but just care about what things I get, like, have I done my homework...[unclear].

MANI: I want to go to Oxford university yeah, but I'm too young, I'm year 8, my mum yeah, got me some Oxford University books, I mean, I'm like year 8 not year 11 when I need these books!

ALL: [Laughs]

NORMAN: That's the typical Pakistani parents!

MANI: She gave me like this thick book and said 'you have to read it in one day' and I was like, 'mum...I would die if I read this in one day....please go away!'

NORMAN: Basically, they're strict...cos my mum, like, she has 4 brothers and was taught by her brothers and she's lucky, cos her brothers...well, basically her dad, use to make them carry stones on their back if they don't get one question right...so that's how hard it was...

MANI: Well we use to get whipped our hands in school...what happen, yeah, you might find this funny yeah, but it's not funny...well...it's kinda funny...basically, my mum yeah, when she was in school, there was these people yeah, my mum's brother was there yeah, to see if she pass or fail their test, and everyone's parents were there yeah, and basically the people give flower necklace to the teachers when they pass yeah, and my mum thought she got passed, so to thank people, she asked her brother 'brother brother give that necklace I want to give to the teacher' yeah, but her brother hit her because when they home, my mum's mum hit her too, and told her she actually failed and shouldn't be happy!...and cos the class moved up to year 5, she had to stay back in year 4...to learn again till she gets it and move up,

ALL: [Laughs]

NORMAN: Yeah, that's the difference in other countries, if you are off target you have to redo the year and if...

MANI: If you give a low level you just move up yeah, to year 9, at the lower sets,

NORMAN: So basically, they have to do it again if they don't get it but we don't we just keep on going up

MANI: But it's unfair yeah, everyone in the top set get to do the year 9 stuff, we don't understand year 9's work...

NORMAN: Yeah, it's so hard...he said to you... that's what you do in GCSE and if you can't do it you go home as failure...that's what he said to us...

INT: What do you think of your parents' expectations? Is it reasonable? Appropriate? Harsh?

MANI: I think it's...

AMY: Mine's alright...

NORMAN: Mine pushes you to do more...

INT: And you? [TO FLORENCE]

FLORENCE: Yeah, just wanted me to be something when I grow up...

INT: Do you guys think Pakistani parents are different from other parents?

NORMAN: Of course

MANI: Of course!

AMY: They're alright actually...

NORMAN: Cos they're born here!

AMY: Yeah...they're born here

INT: What's the difference do you think?

AMY: I don't know, cos my mum's parents were strict on her...but she's not as strict...on me

MANI: My mum is not that strict to me yeah, but then when she sees other parents being strict to their children yeah, she copies them and be strict to me and I was like, 'mum, you're MY mum, don't try copy other people'

NORMAN: My mum, she's actually from Dubai but when she was young she moved to Pakistan with her parents, and basically, she's been brought up there...

INT: What are other parents like do you think? Are Pakistani parents stricter?

NORMAN: More than strict!

AMY: My cousins, cos their parents were born in Pakistan, all their parents want them to be doctors and one of my cousins wants to be a lawyer, and she goes 'no, lawyers are bad, be a doctor...saves life'.

NORMAN: I think some other parents are loose, they just like, let them...in this country, basically, they just don't really care, they just want [unclear] –

MANI: You know, my mum's friends yeah, when they are strict on their children yeah, it's like no fashion, no makeup, no [unclear]...my mum don't really care, I'm her child...yeah, so whatever suit me yeah, so when I go to festival yeah, I wear makeup and do fashion yeah and then yeah, my mum's friend is there and it's like, [MIMIC] 'Oh my god...your daughters wearing this...' and then my mum's like, yeah, looks at me and feels...she's not embarrassed yeah but she just looks as if she wants to slap me in the face, but I mean, why do they care, I'm not their child...she just gets like...

NORMAN: Basically, my mum say that 'you have to be good' and they tend to talk about you behind your back...I mean, like, they talk about us and if you're bad, her reputation will be bad...

INT: Does that happen to other people as well?

NORMAN: Basically, what it is...if you're Pakistani, you have to be good...and they have high expectations

AMY: Oh yeah, oh my god...

NORMAN: It's like if you're not good they won't let you in the house...

AMY: I was in Pakistan like 4 years ago and there was a school like just outside where we live, and we went there, and all we see is kids getting whipped and I was like 'oh my god' and I was just walking pass and... they're so racist, they thought I was white...you know what Pakistani say about white people...

MANI: [laughs] Racist!

ALL: [Laughs]

NORMAN: Basically Pakistan people are stupid...cos they think, if your white, skinny and handsome, and if you call someone fat, then you're a racist...that's just so stupid...

INT: Are there any gender differences from parents...as in; is there any difference between boys and girls and what parents expect them to be?

MANI: Yeah, it's so rude yeah, boys, yeah, can go out at night but girls can't...so rude...

NORMAN: Basically...yeah, cos my parents, yeah, cos I live far, I live in *Carton*, and they don't let me travel by myself, so for any distance, like, more than 2 miles, they go like, 'oh oh, I'll take you by car, I'll take you by car' cos they're scared that I will get stabbed...they hear these stupid things on the news and think I will get stabbed and they pinpointed me and say, 'you, YOU are going to get stabbed'.

ALL: [Laughs]

NORMAN: ...saying that...and so, I mean, you can get a bus from *Carton* to here...

INT: OK...erm...what type of jobs do you think is typical for Pakistani people in Britain?

NORMAN: Doctor!

AMY: They work in Pharmacies

NORMAN: Yeah...and corner shops

MANI: Yeah

NORMAN: It's like they have nothing else...no qualifications

INT: Un-huh...what other jobs is quite typical do you think? We have pharmacy, doctors and corner shops...

NORMAN: Curry shop!

AMY: Yeah, curry!

MANI: I don't think it should be called curry shop, cos, just because, yeah, I just think curry shops should be banned in the whole of Britain yeah, and only in Pakistan and India yeah...cos, like, people who are Pakistani here yeah, people just go and think [MIMIC] 'oh look, the curry person, the curry person'.

NORMAN: Yeah, there's curry shop, corner shop, pharmacy, mostly doctors...I mean, people who are born here are high achievers because their parents are really strict...erm...sweeper if don't achieve!

ALL: [Laughs]

NORMAN: If you don't achieve yeah, and becomes a sweeper, your parents are like...

MANI: They don't want you!

NORMAN: Yeah, they just delete contact with you!

MANI: They just like, ok, goodbye!

AMY: Kick you out of the house

NORMAN: They will change their address and change the locks and stuff

ALL: [Laughs]

INT: So your parents expect a lot from you?

ALL: Yeah, a lot!

INT: Do you expect yourselves to do very well too?

MANI: Yeah...

NORMAN: Yeah, cos I'm in the top set for everything and they're happy as well...

INT: Ok, now, moving onto the final points, now...some people say that science is for people who are...white, people who are rich and people who are men...

MANI: That's racist...and sexist...only man yeah, what about girls?

NORMAN: Mostly are white people that are...

AMY: That is true...but most Asian men are doctors...I haven't seen many...

MANI: Sexist!

AMY: I'm not I'm a girl and...

NORMAN: Most doctors are men and not women cos they're probably into fashion and stuff like that but there are a two Asian science teachers here...but there are more white peoples...but I think everyone can be like...erm...

MANI: Yeah... yeah....there was one Pakistani teacher here yet and she got kicked out...

AMY: She was pregnant...twice

MANI: Twice! Oh...ok...yeah, but, she should be back by now

NORMAN: No, it's maternity leave...hmn...Also...I don't think you have to be rich to do science! [TAKES SWEETS SUSPICIOUSLY]

ALL: [Laughs]

AMY: Some people think you have to be rich to go to university...even though you need to pay for it, you don't have to be rich; you can get money and work for it...

INT: Do you guys know any famous scientist?

NORMAN: Frankenstein...no, no...Einstein or something like that...

AMY: Do all scientists have blown-up hair? And they wear glasses?

NORMAN: I heard Einstein was an illiterate...he can't read or write, but he invented the nuclear bomb for some reason...

INT: Hmm...what do you guys think...because scientist tends to be white, tends to be man and tends to be from rich background? What do you think? Is science for girls?

NORMAN: I don't think...

AMY: Both

NORMAN: Nowadays, girls are like into hairdressing, doing their face and makeup...

ALL: [laughs]

INT: Do we agree?

MANI: I agree because I do that!

NORMAN: I agree!

INT: So science is not for girls?

AMY: But...if some girls want to be like...erm...like makeup and stuff, they need science, like a beautician or something... you need science....

INT: Hmm...what about this idea that science is for white people?

MANI: Racist!

AMY: Yeah that's racist!

INT: So is science for everyone?

ALL: Yeah

NORMAN: Except...it's not for people that can't speak English!

ALL: [laughs]

NORMAN: Some people can't teach...can't understand their accent. Basically if you're born here you can teach science but if you're from another country, and you're fluent in English then you should teach, but if English is not their language then they should not use big key words, just use simple key words.

INT: Ok...that's quite interesting....so is science for girls?

AMY: If some girls are really into science they can do it, if some not then...no

NORMAN: You see some girls yeah, they put up the book and start doing makeup! Putting makeup on!

ALL: [Laughs]

INT: Is that true? [TO THE GIRLS]

AMY: No!

MANI: I sometimes do that I admit but the thing is yeah, when I'm bored I do my nails or just do my makeup!

INT: Is that just in science or in other classes as well?

AMY: In science yeah I have a nail-filer...do just my nails, depends on the teachers!

MANI: I do it in every class!

INT: So...the overall picture we're getting is the teachers...

AMY: Yeah the teachers, especially Ms. Smith, Mr. Seabass and that's all...

NORMAN: Yeah, that's it!

MANI: The teachers can improve...Ms. Smith yeah, proper clothing!... Mr. Ashalaka...he needs to learn speak English; he needs to calm down...release. Mr Tallman...he needs to give us more time to work...he gives us like 5 seconds to work in year 7...like, '5-4-3-2-1...ok that's it', it's so unfair.

NORMAN: My teachers give too much detention! Ms. Smith...people say she can't teach!

INT: Ok...can anyone here imagine themselves to be a scientist in the future?

MANI: I can I can...[laugh]...I can imagine wearing a white coat and my hair all stick up!

ALL: [Laughs]

NORMAN: With glasses and lab coat!

AMY: Yeah

ALL: [Laughs]

INT: Do you guys see yourself more likely to be a doctor than a scientist?

MANI: Doctor!

NORMAN: I think...maybe IT and stuff

MANI: I had a dream yeah, that I was a doctor with a patient yeah....

NORMAN: [Laughs]

MANI: And I have a patient outside, anyway!...but I was actually doing my makeup and saying 'yeah, hang on, I've got a patient inside!' [laughs] and actually doing my make up!

NORMAN: Basically doctors get like 150,000 a year but because you can save life, you get rewarded also in my religion, Islam, saving life, so basically, that's why it's doctors, and doctors can't get effected by the recession...you need doctors everywhere in the world...the hospitals and surgeons will not be effected!

INT: OK, well, I think time is up now, thank you so much...I think I will stop the recording here.